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THIRD ANNUAL REPORT

OF THE

State Department of Health

OF

MASSACHUSETTS

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Supervisor of Administration

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THIRD ANNUAL REPORT

OF THE

STATE DEPARTMENT OF HEALTH

OF

MASSACHUSETTS.

For the fiscal year ending Nov. 30, 1917, the State Department of Health was constituted as follows: —

Commissioner of Health, ... Allan J. McLaughlin, M.D.

Public Health Council.

Allan J. McLaughlin, M.D., *Chairman.*

George C. Whipple, S.B., 1920.
Wm. T. Sedgwick, Ph.D., 1920.
Wm. J. Gallivan, M.D., 1919.
John T. Wheelwright, 1919.
David L. Edsall, M.D., 1918.
J. E. Lamoureux, M.D., 1918.

During the year seventeen formal meetings of the Council were held, and in addition numerous meetings of the standing and special committees of the Department. The standing committees are as follows: —

Sanitary Engineering (including Housing and Rural Hygiene).

Professors Whipple and Sedgwick, Dr. McLaughlin and Mr. Wheelwright.

Preventive Medicine and Hygiene.

Drs. Edsall, Gallivan, McLaughlin and Lamoureux.

Food and Drugs.

Professor Sedgwick, Drs. Gallivan and Lamoureux.

Finance, Law and Demography.

Dr. McLaughlin, Professor Whipple, Dr. Gallivan and Mr. Wheelwright.

Aside from the valuable assistance which the members of the Public Health Council have rendered through the standing committees, Dr. Edsall and Dr. Gallivan, as chairman and member, respectively, of the committee on the conservation of child life, have given unsparingly of their time and energy; Dr. Gallivan and Dr. Lamoureux have conducted as representatives of the Council hearings on the contracts between certain of the county commissioners concerning the care of persons suffering from tuberculosis; Professor Whipple and Professor Sedgwick have given at all times the benefit of their knowledge and advice on matters pertaining to water and sewage especially; and Mr. Wheelwright's recognized ability as a lawyer has been called upon many times during the past year in legal matters.

In accordance with section 2, chapter 792 of the Acts of 1914, at a meeting of the Public Health Council on Jan. 22, 1918, the Commissioner of Health submitted to the Council a report of the work of the Department for the fiscal year 1917, together with recommendations for legislation, and it was voted that this report be approved and adopted as the report of the State Department of Health for the fiscal year 1917.

REPORT OF THE COMMISSIONER OF HEALTH.

In accordance with chapter 792 of the Acts of 1914 I have the honor to present the following report of the work of the State Department of Health for the fiscal year 1917. As in the previous year the organization of the Department into seven divisions was continued, the list of divisions and directors being as follows: —

Division of —	Director.	Salary.
Administration,	L. A. Jones, M.D. (acting),	-
Sanitary Engineering,	X. H. Goodnough,	$5,000
Water and Sewage Laboratories,	H. W. Clark,	4,000
Communicable Diseases,	E. R. Kelley, M.D.,	4,000
Food and Drugs,	H. C. Lythgoe,	3,500
Biologic Laboratories,	M. J. Rosenau, M. D.,	1,500[1]
Hygiene,	L. A. Jones, M. D.,	3,500

[1] Part time.

Division of Administration.

The Division of Administration consists of the subdivisions of records and accounts. The system of central buying for the Department is now well established, and has been operating satisfactorily for some time past. A complete report was filed by the property board of the Department in December, including such recommendations as will tend to improve the system of property conservation and record.

Division of Sanitary Engineering.

The total number of applications received from cities, towns and others for advice in regard to water supply, sewerage and similar subjects presented for the consideration of this Division during the year 1917 was 141 as compared with 154 in 1916. This difference was due almost wholly to the reduction in the number of applications received in the month of November. The general character of the work called for under these applications has been much the same as in former years. In addition to their regular activities, considerable work has also been done by this Division on the water supply, sewerage and sanitation of camps.

A number of special duties were imposed upon the Department by the Legislature of 1917 which have been referred to this Division for investigation and report. These were —

1. Drainage of marshes and low lands along the Neponset River and the shores of Dorchester Bay. (Chapter 52, Resolves of 1917.) Appropriation, $2,000. Report, Jan. 10, 1918, with drafts of bills.
2. Improvement of Hale's or River Meadow Brook in Lowell. (Chapter 92, Resolves of 1917.) Appropriation, $1,000. Report, Jan. 10, 1918.
3. Use of summer flow of the Ipswich River for the water supply of Salem and Beverly. (Chapter 73, Resolves of 1917.) Appropriation, $250. Report, Jan. 15, 1918.
4. Examination of domestic water supplies owned by individuals. (Chapter 90, Resolves of 1917.) Appropriation, $2,500. Report, Jan. 9, 1918.
5. Drainage surveys, jointly with the Board of Agriculture. (Chapter 212, General Acts of 1917.) Appropriation, $2,000. Report annually.
6. Investigation of Mystic Lake and its tributaries jointly with the Metropolitan Park Commission. (Chapter 45, Resolves of 1917.) Report, Jan. 2, 1918.
7. Investigation of sewage discharged into Boston Harbor. (Chapter 56, Resolves of 1917.) Appropriation, $5,000. This work is under the direction of a special commission consisting of the chairman of the Metropolitan Water and Sewerage Board, the Commissioner of Health of the State Department of Health, and the Commissioner of Public Works of the city of Boston. Report, Jan. 9, 1918.

In May, four of the experienced engineers of this Division who had been in the employ of the Department for several years resigned, three of them to join the army and one to take a similar position with another State board of health at a much higher salary. Other engineers were engaged to take their places, but these left the Department later on, either to enter military service or to engage in the construction of camps. Up to the end of the year it has been found impracticable to secure properly qualified assistants for the vacancies in this division.

The work of determining the ownership and area of lands benefited by the improvement of the Neponset River also has been greatly hampered by the fact that four experienced engineers engaged in this work left the Department during the summer to enter military service. Others engaged to take their places soon resigned for the same reason, and it became necessary, in order to carry on this work, to engage younger men for the most part, not subject to draft, and train them specially for this work. Consequently, there has not only been serious delay but the cost of the work has been greatly increased, and further funds will be required in order to complete it.

In consequence of the lack of a qualified engineering force much of the work committed to this Division early in the summer of 1917 remains as yet uncompleted. The surveys of the marshes and low lands along the Neponset River and the shores of Dorchester Bay are nearly completed, and a report can probably be made of this work at no distant time if no further difficulties are encountered.

A small amount of work has been done upon the examination of domestic water supplies owned by individuals, and interesting results have already been secured.

In the matter of drainage surveys with the Board of Agriculture a very considerable amount of work has been done in determining the character of the soils of the wet lands of the State, both the fresh-water swamps and the salt-water marshes, a survey has been made of the Weweantic River, and valuable information collected relative to certain other streams. The total amount of work done, aside from the determination of the character of the soil of the wet lands, has been small compared with the amount required.

In the matter of the investigation of Mystic Lake and its tributaries the data already available in this Department have been collected.

The question of the discharge of sewage into Boston Harbor has been under investigation during the year, and all information practicable has been collected relative to this subject.

Nothing has been done upon the surveys for the improvement of

River Meadow Brook in Lowell, or upon the use of the summer flow of the Ipswich River for the water supply of Salem and Beverly. In the case of the latter investigation a much larger sum of money will be needed to carry out the work than was provided in the appropriation of 1917. As already indicated, an additional sum will also be required for completing the work preparatory to assessing the cost of the Neponset River improvement.

Division of Water and Sewage Laboratories.

Chemical, bacterial and microscopical examinations of samples of the water supplies, rivers, etc., of the State were made during the year, this work necessitating the making of 5,200 chemical, 1,800 bacterial and 1,543 microscopical examinations.

Studies of sewage areas, purification of sewage, trade wastes, purification of water and the examination of shellfish called for 2,431 additional chemical and 1,200 bacterial examinations.

Investigations were made of the disposal and purification of manufacturing wastes from about twenty-five industrial works, and special studies in regard to several upon which reports were made to the Department.

Extended studies for the special commission of the Legislature were made in regard to the sewage entering Boston Harbor and its value on account of fatty matters and fertilizing constituents and the amount that could be recovered by acidification of the sewage, etc.

Studies in regard to the purification of sewage by the activated sludge process were continued with promising results.

Investigations were made in regard to the passage of liquids through tanks of different forms and baffled in different ways, this being especially important in connection with the activated sludge process.

Work was done in regard to the pollution of various small rivers in the State, especially the Aberjona River which has received serious pollution from the Merrimac Chemical Works.

Extensive experiments were made on the removal of color from water in specially prepared filters rather than by the use of chemical precipitants applied directly to the water. These studies have given results of interest and possible value.

Division of Communicable Diseases.

The most noticeable feature pertaining to the work of the Division of Communicable Diseases for the past year is the remarkably small number of epidemics or outbreaks of magnitude. One school epidemic

of diphtheria with 320 cases, one institutional epidemic of dysentery with a total of 60 cases; three epidemics of septic sore throat with 42, 119 and 50 cases, respectively; one epidemic of smallpox with 40 cases; and two epidemics of typhoid, one milk-borne, occurring in two distinct outbreaks several weeks apart but both due to the same carrier, with a total of 74 cases, and one institutional typhoid epidemic with 65 cases, constitute the entire record of serious outbreaks of communicable diseases for the year.

Numerous minor outbreaks with relatively few cases each, numbering in all 210, due chiefly to diphtheria, measles, scarlet fever, typhoid fever and whooping cough, occurring in all parts of the State have been studied, causes determined, and measures put in effect to check their further spread, to a more satisfactory degree than in any previous year. It is worthy of note that but one distinct outbreak of poliomyelitis occurred during the year, having a total of 42 cases.

There has been a very pronounced increase in diphtheria in many cities and towns without the situation becoming at any time definitely epidemic. Better methods of school inspection are needed for combating diphtheria of this endemic type.

Anti-typhoid vaccination of employees and inmates of State institutions has been greatly extended. Unfortunately, a sharp institutional outbreak was needed to supplement the advice of this Department, given by circular two years ago, to State institutions to carry out such procedure as a routine.

The year has been marked by satisfactory progress in the construction of county hospitals for consumptives. The Barnstable County Infirmary is practically completed. Franklin, Berkshire and Hampden counties have made satisfactory contract arrangements with existing institutions. Bristol, Essex, Middlesex, Norfolk and Plymouth counties each have new institutions under construction.

The war has deeply affected the routine work of the Division. One District Health Officer is serving as an army medical officer overseas. The epidemiologist is awaiting orders. A complete system for the sanitation of the extra cantonment zone of Camp Devens took much of the time of two District Health Officers. By a system of direct reporting from the local exemption boards appointed under the selective service act to this department nearly 1,000 cases of positive or suspected tuberculosis have been brought to light. The increasing complexity of the tuberculosis problem as illustrated by the finding of so many hitherto unsuspected cases among drafted men emphasizes again the urgent need of nurses trained in public health field work to assist the District Health Officers.

The problem of venereal diseases has received much attention by the Division throughout the year, and the details of a program for handling the reporting of these diseases has been formulated.

It is difficult to indicate the great variety of work performed by the District Health Officers annually without going into details inappropriate to this place. Some idea of their work may be obtained by noting that the aggregate mileage of the District Health Officers during the year is approximately 100,000 miles, an average of over 12,000 miles each. They have inspected and reported upon the work of each of the 53 tuberculosis dispensaries twice during the year. They have inspected and reported upon the sanitary condition of 195 lockups and detention houses, and 76 hospitals caring for diseases dangerous to the public health, once each during the year. They have conferred with and advised, from once to many times, with practically every local board of health in the Commonwealth upon matters affecting the public health. The District Health Officers and epidemiologist together have made individual investigations of practically all cases of anthrax, epidemic cerebrospinal meningitis, smallpox, pellagra, poliomyelitis, tetanus and trichinosis that have been reported. They have also carried out individual investigations of about 50 per cent. of all typhoid cases reported, in addition to the investigation of epidemics and outbreaks previously mentioned.

The work of the Diagnostic Laboratory has increased slightly in the total amount of examinations made during the year, 22,478 specimens being examined as against 22,140 in the previous year. The most significant increase is the number of culture examinations for typhoid fever, 716 such examinations having been made, 47 of which were positive, 8 chronic typhoid carriers being located by this means. In all, 27 known chronic typhoid carriers are now kept constantly under supervision by the State Department of Health and local boards of health as a result of the discoveries made in the laboratory in the past few years. The work of the Diagnostic Laboratory has been greatly facilitated by obtaining a long-needed expansion of quarters. Diagnostic examination of pneumonia sputum to determine type of infection and type of serum suitable for treatment has been added to the work of the laboratory during the past year.

Division of Food and Drugs.

This Division has been carrying on the usual activities imposed upon it by statute. During the year there have been examined 9,923 samples. The Division has prosecuted 299 cases and secured 267 convictions, the total fines imposed amounting to $5,680.60.

One of the innovations during the year has been the successful use of the false advertising law in connection with the sale of old eggs as strictly fresh eggs. A thorough survey of the sausage factories located in the State has been made, with particular reference to the use of rotten meat. In two instances tuberculous tongues were found on sale.

A survey has been made of the bakehouses throughout the State relative to the use of eggs. All the cold-storage warehouses have been inspected several times during the year. A very large number of requests were made for extension of time in storage of poultry. The Federal Food Administrator made a definite request regarding the length of extensions on poultry, which request has been adhered to, viz., that an extension of four months be granted for one-half the amount in storage and of one month upon the balance.

Several meetings of local inspectors of slaughtering have been held, and the reports of our inspectors as to the improvement in the character of work done have indicated that the meetings were of considerable benefit.

The Division has been endeavoring to establish the manufacture of salvarsan upon a commercial scale. The principal difficulty in doing this is lack of space. Most of the difficulties have been solved, and the article will be manufactured on a large scale throughout the coming year, when the necessary space has been allotted to the Division.

Division of Biologic Laboratories.

There was an unusual demand for biologic products during the fiscal year 1917; for example, 175,223 doses of vaccine virus were distributed, which is more than in any previous year. To satisfy the demand for diphtheria antitoxin required 225 gallons of this curative and protective serum, representing 219,013,000 immunity units. This is somewhat over twice the amount distributed the previous year. The new products added were paratyphoid and dysentery vaccines and anti-pneumococcus serum. This large increase in the number and quantity of products distributed made it necessary to practice the strictest economy in order to remain within the limits of appropriations, particularly in view of the increased cost of materials and labor.

Over 28,000 Wassermann tests were made at a cost of about 20 cents per test. The commercial price for this test is $5. This service has been simplified and improved by opening the tests directly to all institutions and physicians of the Commonwealth. We continued to co-operate with the Bureau of Animal Industry in making diagnostic examinations for rabies, tuberculosis, glanders, anthrax, hemorrhagic septicemia, etc.

Some of the vaccines and serums were used by both the army and navy, and the laboratories furthermore co-operated with the military establishment in various other ways. Formerly all the special filter paper used in concentrating diphtheria antitoxin was made in Belgium. We have been seriously handicapped in refining and concentrating this serum on account of the difficulty of obtaining filter paper suitable for dialysis.

The work of the Division has been increased, the number of its products multiplied and the quality of its service improved.

Division of Hygiene.

The importance of infant and child welfare work has been particularly emphasized during the year. Three public health nurses, two added during the year, have been active in this work. Two of the nurses have accompanied the child welfare exhibit, which has been displayed in 24 communities and at 10 of the fall agricultural fairs, reaching an estimated attendance of 60,000. Of the lectures given during the year some 250 or more had to do directly with infant or child welfare, including the school period.

The third nurse is employed in making detailed studies of conditions affecting child life in smaller communities, and arousing interest therein, so that the community will itself provide means to institute or carry on such child welfare work as is shown to be necessary.

This work has been greatly extended through the efforts of the child conservation committee composed of representatives from the Department and advisory members, — specialists from outside.

In connection with this branch of the work about 60,000 copies of the "Baby and You" have been distributed, and a series of prenatal letters have been prepared, for which a gratifying number of requests are being received.

During the year 424 lectures have been given with a total attendance of more than 50,000.

A qualified worker has been added to the staff of the Division to speak and write upon food topics.

The volunteer offer of the Harvard Cancer Commission to examine specimens of pathological tissue for physicians was made available through this Division.

Organization and Space.

Our organization is effective and securing excellent results, but two problems demand solution: first, provision for the enormous and ever-increasing volume of work demanded of the District Health Officers;

and second, the securing of proper quarters for the laboratories of the Department.

I am constantly impelled to place new duties on the District Health Officers, but there is a limit to human endurance. Hundreds of cases of tuberculosis have been reported through our utilization of the draft machinery, and follow-up work on these cases has greatly added to the duties of these men. We have instituted a comprehensive plan for the suppression of venereal diseases, and the carrying out of the details of this program must also increase their work. Furthermore, I have asked the District Health Officers to make a complete sanitary survey of each city and town in their districts, and report with conclusions and recommendations thereon, in order that the Department may properly advise in the improvement of health administration in cities and towns.

These are merely descriptive of some of the additional problems placed upon the District Health Officers at this time, when they are already working almost up to the limit of their time and endurance. In carrying on their work, naturally the most pressing problem, as, for instance, an epidemic, is given precedence, and the routine and clerical work fall behind. After careful consideration I have decided that the best way to relieve the burden on the District Health Officers at the least expense is to place in each district a public health nurse who could perform many routine duties in the field and carry the clerical work in the office, thus making it possible for the District Health Officer to devote more time to the larger and more important problems of his office.

The laboratories of the State Department of Health and their locations are as follows: —

Laboratory.	Location.
Water and Sewage Laboratory,	State House.
Lawrence Experiment Station,	Lawrence.
Diagnostic Laboratory,	State House.
Antitoxin and Vaccine Laboratory,	Forest Hills.
Wassermann Laboratory,	Harvard Medical School.
Food and Drug Laboratory,	State House.

Our laboratories have been seriously hampered by lack of space. The manufacture of arsphenamine on a large scale has been delayed at least six months by the failure to secure adequate quarters for the Food and Drug Laboratory.

The space now occupied by the Antitoxin and Vaccine Laboratory at Forest Hills is desired by the Harvard College Corporation, and we have been requested to vacate at the earliest possible moment. Since the matter of providing other arrangements for the housing of the Antitoxin and Vaccine Laboratory is thus forced upon us at this time, it would seem a much wiser and more economical plan to consider the entire matter of laboratory accommodations for the Department rather than to spend a large sum of money on the carrying out of a piecemeal plan which would only provide for the Antitoxin and Vaccine Laboratory.

Accordingly, I have appointed the following special committee on laboratories for the purpose of considering a comprehensive plan for the housing of all the laboratories of the State Department of Health, bearing in mind the fact that this Department may eventually take over all the laboratory activities of other departments of the State government, and also that our laboratory service may be extended to include the examination and testing of certain materials and supplies used by the State.

Special Committee on Laboratories.

Dr. Wm. J. Gallivan, *Chairman.*	Prof. Wm. T. Sedgwick.
Prof. G. C. Whipple, *Recorder.*	Dr. M. J. Rosenau.

This committee is now at work upon a plan for combining and housing the various laboratory units of the Department into a single properly designed and constructed laboratory building.

The Proportionate Allotment of Time and Money in a Health Department.

The executive health officer must make a constant effort to maintain his sense of proportion. Appropriations and hours in each day are limited, and he must so employ both money and the time of his subordinates that the greatest return, measured in terms of disease prevention and life saving, may be secured.

Such an adjustment demands that a large proportion of time and money be allotted to infant mortality, child welfare, tuberculosis, venereal diseases and pneumonia. The great possibilities of preventive work in so many diseases by means of health instruction compel the wise health officer to devote considerable time and money to educational work in personal hygiene by means of lectures, health exhibits and literature.

Infant Mortality and Child Welfare.

This Department has now, through its child conservation committee, put into effect an intensive campaign of baby saving which will cover the entire State. Specific recommendations will be made to each city and town showing definitely what agencies should be installed to secure the maximum reduction in infant mortality.

In a time of national stress conservation requires no argument, and in many ways child conservation is the most valuable type of conservation. The results of war conditions with the great loss of man power accentuate tremendously the importance of baby saving. Germany has demonstrated that by intensive methods of child conservation enough lives of babies can be saved, over and above those saved by ordinary methods in time of peace, to replace in a few years the man power lost because of the war.

Massachusetts has been in the forefront in baby saving, and now has an opportunity of greatly increasing child conservation by assisting those agencies already engaged in child hygiene, and by stimulating the establishment of such agencies in cities and towns where little work is being done. This seemed to me the psychological moment to launch an intensive campaign for child conservation. Accordingly, on May 26, 1917, I appointed the following committee: —

Committee on Child Conservation.

David L. Edsall, M. D., *Chairman.*
Wm. J. Gallivan, M.D.
Lyman Asa Jones, M.D., *Recorder.*

Advisory Members.

Robert L. DeNormandie, M.D.
Walter Fernald, M.D.
William Healy, M.D.
Richard M. Smith, M.D.
Fritz Talbot, M.D.
Miss Mary Beard, R.N.
Mrs. William Lothrop.

In selecting the personnel of this committee, specialists in all phases of child welfare work were included. The scope of the work is intended to cover every phase of child welfare from prenatal care to the age when children enter school.

The specific object of the work of the committee is to demonstrate to cities and towns the necessity for child conservation work, and to point out the agencies needed for baby saving by that particular town. It will also be a part of its work to stimulate the communities through-

out the State to provide funds for the employment of trained workers to carry on this work in each community.

The work will be done by child welfare supervisors, — especially trained and experienced nurses, — one for each of the eight health districts in the State. These supervisors will work in co-operation with the local health officials and the State District Health Officer in each district, making surveys of individual communities and discovering what the actual health conditions are. When the special problem of a city or town has been determined, definite effort will be made to prevail upon that city or town to provide funds to meet its individual needs.

Funds for the payment of the salaries of these supervisors have been secured from the Red Cross, thus saving the State funds as far as possible, and enlisting a widespread outside interest. Appreciating the importance of such measures, the Governor set aside from the emergency fund the sum of $5,000 to be expended by the State Department of Health for the purpose of meeting the expenses of these field workers.

The results obtained by these field workers are now being made available, and the committee is beginning work on recommendations for each city. The first surveys and specific recommendations will be for cities and towns of over 30,000 population. Later it is hoped to cover the entire State. These recommendations will be considered by the Public Health Council, and advice based thereon will be given by the Commissioner of Health to the city and town authorities. The committee, working through subcommittees in each city or town, will use every effort to secure the needed improvement in, or establishment of, baby-saving agencies.

In connection with this subject must be considered the medical inspection of school children. The unrealized possibilities of a system of medical inspection of school children, due to the fact that the present system in Massachusetts lacks uniformity of method and breadth of scope, place upon the executive health officer of a State the obligation to suggest a remedy which will correct these defects by providing proper minimum standards of work, and proper central supervision to see that these standards are maintained. Accordingly, a bill has been introduced this year which, if passed, will accomplish this result.

Tuberculosis.

We have formulated, and with no small effort have put into effect, a program of attack upon the tuberculosis problem, which provides, in city and county hospitals either built or under construction, sufficient bed capacity for all tuberculous persons in need of hospital or sanatorium care. We have secured the establishment of a tuberculosis dispensary with a visiting nurse or nurses for follow-up work in every city and town in the Commonwealth with a population of 10,000 or more.

Measures for Increased Control of Tuberculosis under War Conditions.

The physical examinations of several million men incidental to the mobilization of a huge army have brought to light thousands of cases of tuberculosis which have hitherto escaped notice. Health officials in their efforts to safeguard the civil population should not miss this opportunity to acquire control over these thousands of additional tuberculosis cases. On the other hand, health officials have an obligation to assist the military authorities in keeping tuberculosis out of the army. With these facts in mind, measures were taken to secure the reporting of cases of tuberculosis to the Department discovered by exemption boards in the course of their examinations under the selective service act. In response to a request from me the Governor sent out the following circular to exemption boards: —

Executive Department, Boston, Aug. 23, 1917.

To Medical Examiners on Exemption Boards.

Gentlemen: — The magnitude of tuberculosis as a war problem in incapacitating soldiers is only second to the casualties due to wounds.

In the French army alone more than 165,000 men have been incapacitated by tuberculosis. These facts place an obligation on medical men in Massachusetts to prevent, in so far as may be possible, the disastrous results of careless or hasty examination of recruits, and to make proper provision for the care of the tuberculous recruit rejected by exemption boards or sent home from the front.

Certain things are necessary to obviate conditions with which France is now struggling.

1. The greatest care must be taken by medical examiners on exemption boards to weed out not only the frank cases of tuberculosis but all cases which are doubtful.

2. All doubtful cases should have a special examination by an expert in the diagnosis of tuberculosis.

3. Names and addresses of all those rejected for tuberculosis, and of all doubt-

ful cases referred to the expert diagnosticians, should be reported to the State Department of Health.

In accordance with law there is in Massachusetts a tuberculosis dispensary in every city and town of more than 10,000 population. The dispensary physicians in these cities and towns, and the eminent experts in our larger cities, should be utilized as expert consultants to the exemption boards to pass on doubtful cases.

Undoubtedly some of the medical examiners on exemption boards are expert diagnosticians, with laboratory and other equipment necessary for diagnosis. Others make no claim to such special training and experience. Examiners are urgently requested to avail themselves of the expert assistance outlined above.

Rejections of the tuberculous will safeguard our men at the front, and reporting of such cases will greatly assist the State Department of Health in its efforts to minimize the danger of tuberculosis in the civilian population.

May I urge upon you, as men interested in medical and sanitary science, that you keep an exact record of the name and address of all persons rejected for tuberculosis, both frank and doubtful cases, and that you furnish this list to the State Department of Health, State House, Boston.

Yours very truly,

Samuel W. McCall,
Governor.

In accordance with this circular exemption boards have been reporting to this Department hundreds of cases of tuberculosis which were not known to exist. These cases are followed up, and with our existing State and local machinery we are able to insure proper treatment and care for practically all of them.

To make the system more complete arrangements have been made with the army medical authorities by which we receive lists of those rejected by the army surgeons after having passed exemption boards. These are followed up in the same way as the names reported by exemption boards.

A circular letter was sent to local boards of health asking them to scrutinize carefully lists of drafted men, and to notify the State Department of Health if any drafted men were on their records as cases of tuberculosis. Such names are forwarded by the Department to the army authorities.

I wish to take this opportunity to thank members of exemption boards who have forwarded to the office of this Department names and addresses of positive or suspected cases of tuberculosis exempted by them in the process of examination of recruits under the terms of the national selective service act.

About 85 per cent. of the local boards have already filed such reports with this office, and as a result we have received reports of approxi-

mately 500 positive and 500 suspicious cases of tuberculosis, the great majority of which have never been reported before. The Department is now referring the names of these cases to the board of health of the city or town in which they have residence, and is urging the boards to take whatever steps may be in their power to see that such cases as need proper medical or nursing supervision, or institutional care, receive it.

If authority is secured from the Legislature to employ a full-time public health nurse as assistant to the District Health Officer in each district, still more efficient follow-up work can be done on cases discharged from the sanatoria or reported to us through the exemption boards or medical officers of the army.

Venereal Diseases.

We have made venereal diseases reportable to this Department by number (except in those cases which do not complete treatment, the *names* of such cases being reported to the Department and then referred to the local board of health of the city or town in which they have residence for action), furnished free diagnostic facilities, and are now ready to distribute free arsphenamine, or salvarsan, for treatment. If the money is appropriated by the Legislature we will be able to complete a chain of fifteen venereal clinics covering the entire State, which will serve as centers for treatment and will safeguard the distribution of salvarsan.

A tremendous popular interest has developed in the venereal disease problem during the past year. There has been a corresponding change in public opinion toward this subject during the same period. Both these phenomena are results of the war.

Two years ago a committee of the Public Health Council deemed it inadvisable to make these diseases reportable for reasons which were excellent at that time. To-day, with greatly changed conditions, I believe that venereal diseases should be made reportable, but not in the same manner as other diseases. Special care is necessary in prescribing the manner of reporting the venereal diseases, and fortunately an amendment to the statutes makes it possible to consider them separately.

Chapter 670 of the Acts of 1913, amending section 8, chapter 75 of the Revised Laws, provides for the reporting of diseases declared dangerous to the public health in the manner already provided by statute, or in such other manner as the State Board (Department) of Health may deem advisable. Accordingly, on Dec. 18, 1917, it was voted that syphilis and gonorrhea be made reportable as set forth in the following regulations promulgated under chapter 670: —

Regulations governing the Reporting of Gonorrhea and Syphilis.

1. Gonorrhea and syphilis are declared diseases dangerous to the public health, and shall be reported in the manner provided by these regulations promulgated under the authority of chapter 670, Acts of 1913.

2. Gonorrhea and syphilis are to be reported (in the manner provided by these regulations) on and after Feb. 1, 1918.

3. At the time of the first visit or consultation the physician shall furnish to each person examined or treated by him a numbered circular of information and advice concerning the disease in question, furnished by the State Department of Health for that purpose.

4. The physician shall at the same time fill out the numbered report blank attached to the circular of advice, and forthwith mail the same to the State Department of Health. On this blank he shall report the following facts: —

Name of the disease.
Age.
Sex.
Color.
Marital condition and occupation of the patient.
Previous duration of disease and degree of infectiousness.

The Report shall not contain Name or Address of Patient.

5. Whenever a person suffering from gonorrhea or syphilis in an infective stage applies to a physician for advice or treatment, the physician shall ascertain from the person in question whether or not such person has previously consulted with or been treated by another physician within the Commonwealth and has received a numbered circular of advice. If not, the physician shall give and explain to the patient a numbered circular of advice, and shall report the case to the State Department of Health, as provided in the previous regulation.

If the patient has consulted with or been treated by another physician within the Commonwealth, and has received the numbered circular of advice, the physician last consulted shall not report the case to the State Department of Health, but shall ask the patient to give him the name and address of the physician last previously treating said patient.

6. In case the person seeking treatment for gonorrhea or syphilis gives the name and address of the physician last previously consulted, the physician then being consulted shall notify immediately by mail the physician last previously consulted of the patient's change of medical adviser.[1]

7. Whenever any person suffering from gonorrhea or syphilis in an infective stage shall fail to return to the physician treating such person for a period of six weeks later than the time last appointed by the physician for such consultation or treatment, and the physician also fails to receive a notification of change

[1] In asking physicians to carry out the provisions of this section, the State Department of Health appreciates that it is asking more than is authorized by chapter 670, Acts of 1913. This courtesy is requested, however, in the interest of the public health to protect the individual who has conformed with the regulations laid down for him.

of medical advisers as provided in the previous section, the physician shall then notify the State Department of Health, giving *name*, *address* of patient, name of the disease and serial number, date of report and name of physician originally reporting the case by said serial number, if known.

8. Upon receipt of a report giving name and address of a person suffering from gonorrhea or syphilis in an infective stage, as provided in the previous section, the State Department of Health will report name and address of the person as a person suffering from a disease dangerous to the public health and presumably not under proper medical advice and care sufficient to protect others from infection to the board of health of the city or town of patient's residence or last known address. The State Department of Health shall not divulge the name of the physician making said report.

In attacking the problem of venereal disease it will be remembered that I recommended the immediate installation of a Wassermann Laboratory to furnish disgnostic facilities free to physicians. I also recommended the manufacture of salvarsan or some like substance by the State for free distribution.

The Wassermann Laboratory was established June 1, 1915, and up to the end of this fiscal year, Nov. 30, 1917, has made more than 60,000 tests free. In 1917, 28,000 tests were made. The furnishing of free diagnostic facilities is an accomplished fact.

The furnishing of free treatment facilities is another story. After months of effort we were able to produce salvarsan on a small scale. Our efforts to produce it on a large scale necessitated more space and special equipment. During the entire year 1917 the Department made every effort to secure the space necessary for this work, but only toward the close of the year was additional space available. The repairs and alteration necessary to make this space usable are not yet completed, and we have been compelled to attempt to produce this substance on a large scale in an already crowded laboratory. In spite of these obstacles we have succeeded, and are now producing on a large scale a substance apparently identical with salvarsan.

Foreseeing difficulties and delays in the production of salvarsan in large quantities, I had expected to employ this time in the establishment of venereal clinics which could be used as distributing centers for salvarsan. My plans and hopes for the establishment of venereal clinics throughout Massachusetts, with at least one night clinic per week, have not been realized. The Boston Dispensary has a night venereal clinic. The Massachusetts General Hospital has a splendid venereal day clinic, but does not operate a night clinic, and is disinclined to do so because of the expense. Strenuous efforts by the District Health Officers are being made that promise some success for venereal clinics in Lowell, Fitchburg and other large cities.

Night venereal clinics are in my opinion essential, as many persons needing treatment are unwilling to lose pay by taking a day off to go to the clinic. On the other hand, the quack nearly always has evening office hours, and the lack of night clinics forces many patients into the hands of the fakir and charlatan.

There should be State supervision of all dispensaries which essay to treat venereal disease. All such should be licensed by the State only after conforming to definite minimum requirements which would protect the patient from imposition and injury.

I believe that the best way to secure the establishment of venereal clinics and to safeguard properly the use of salvarsan is to subsidize the clinics, the State paying a part of the expenses, not to exceed $1,000 annually to any one clinic; and accordingly, I included in my estimates for the coming year an additional $15,000 for this purpose. By placing dispensaries in twelve large cities serving as centers the entire State will have free dispensary facilities. By partially defraying the expenses of the clinics to the extent of $1,000, and by furnishing free salvarsan, we will be able to put into effect minimum requirements for establishing and maintaining such dispensaries which will insure proper and successful operation.

When the dispensaries are available the campaign against the quack must be pushed vigorously. There is one other cause, however, which contributes greatly to the appalling results of bad treatment, viz., the treatment of venereal diseases by drug clerks. The records of some of our dispensaries show that an alarming percentage of their cases of venereal disease have been previously treated by drug clerks. Since syphilis and gonorrhea have now been added to the list of reportable diseases, and declared dangerous to the public health, a druggist has no more right to treat them than he has to treat smallpox, scarlet fever or diphtheria. For these reasons I have included in the legislative recommendations a bill to prohibit the dispensing by druggists of remedies for the treatment of venereal diseases except upon the written prescription of a physician.

A bill has also been introduced declaring records of venereal diseases on file in this Department private, and providing for their destruction after they have served their purpose.

In the meantime a sane educational program is being carried out to disseminate knowledge of the dangers of venereal disease. In this program we are utilizing lecturers of both sexes, lantern slides and pamphlets.

Pneumonia.

The Department made pneumonia a reportable disease during the past year. We are now manufacturing and distributing free anti-pneumococcus serum for Type I. and Type II. pneumonia. We have added to the diagnostic laboratory facilities for differentiation in types in pneumonia sputum in order that the serum, which is limited in amount, will be used only for the cases in which it is effective.

The efficacy of Type I. serum seems to be demonstrated. The serum for Type II. is also promising, and by the end of the year we will have sufficient data upon which to base definite conclusions as to the life-saving value of these sera.

Medical Examination of Prisoners.

In my first annual report I referred to the thousands of prisoners turned loose yearly from jails and correctional institutions to spread disease, especially tuberculosis and the venereal diseases. I believe that every person who receives a jail sentence, or who is sent to any State, county or city institution, should have an accurate physical survey recorded upon a card showing his or her physical status and the presence or absence of venereal or other communicable disease.

There is a law now on the statute books which provides for the treatment of inmates of charitable institutions or prisoners in penal institutions who are suffering with syphilis, and which further provides that on the expiration of sentence, if still afflicted, they may be detained for further treatment. The Department has made progress along this line, and thousands of Wassermann tests have been made of inmates of charitable institutions and prisoners in penal institutions.

The machinery for examining properly and recording the physical condition of short-term prisoners, however, does not exist, and should be installed if we hope to control this dangerous element in the spread of venereal disease. The chronic inmate of an institution and the long-term prisoner are less dangerous in spreading disease to the public than the short-term prisoner who is discharged without medical examination. Accordingly, I have submitted to the Legislature the draft of a bill which, if passed, will secure physical examination and proper record of all prisoners under sentence of thirty days or over, the examination and record to be made under minimum requirements prescribed by this Department. The proposed bill has the endorsement of Colonel Adams, Director of Prisoners, who will lend his support to its passage.

Increase in Work of the Department due to War Conditions.

The work of the State Department of Health has been greatly increased because of war conditions and their attendant problems, chief among which has been the sanitation of the zone about the military camp at Ayer. In connection with the war work of the Department may also be mentioned the appointment of the State Committee on Hygiene, Medicine and Sanitation, and the duties of this committee.

Sanitary Organization of Zone about the Military Camp at Ayer, Mass.

The Department was able to render very valuable assistance to the army in the selection of the site and in making provision for water and sewerage systems for Camp Devens. The advice of the chief engineer of the Department, and the very complete data available in the Division of Sanitary Engineering, was utilized by the army as a basis for its work.

The towns in which the camp is located, together with those adjoining, are Ayer, Littleton, Harvard, Lancaster, Shirley, Townsend, Groton and Pepperell, having a population, according to the 1910 census, of from 1,034 to 2,955, aggregating 16,543. During the next five years they gained in population but 397. These towns are as well organized for the preservation of health as the average Massachusetts town of their size. They have the usual sanitary conditions, consisting of little else than a good water supply. Harvard and Townsend are the only ones without a public supply for their thickly settled districts. None have a public sewer system; consequently most of them have cesspool, drainage and privy nuisances. But few have efficient milk inspectors. All have inspectors of slaughtering, but no inspectors of provisions. All have medical inspection of schools, but not of an intensive character. Ayer, Lancaster and Pepperell already have public health or district nurses, including school nursing, while Groton and Shirley have plans nearly perfected for employing similar workers.

Realizing that it would be an injustice to tax the towns for more than would be required for a first-class health organization in ordinary times, I addressed the following communication to His Excellency the Governor of Massachusetts: —

May 21, 1917.

To His Excellency, Hon. Samuel W. McCall, *Governor of the Commonwealth of Massachusetts, State House, Boston, Mass.*

Sir: — I have the honor to invite attention to the very serious sanitary problem which presents itself in connection with the proposed military camp at Ayer. It is proposed to place 30,000 men for training in this camp. There will be undoubtedly a surplus population of 8,000 or 10,000 civilians suddenly added to the population of Ayer and the surrounding towns. Camp followers, unlicensed venders of food and drink, prostitutes and other persons disposed to disregard law and ordinances will drift into this area.

Within a radius of 10 miles from Ayer as a center there are 15 towns with populations ranging from 800 to 3,000. Manifestly, these towns are unable to finance a proper health organization, and it would be unfair to expect that of them. Experience in England and France has proved that to avoid disaster the complete sanitary organization should be in the field working long before the recruits begin training. The Federal government, under existing law, is restricting its sanitary work to the care of the soldier and his camp. A bill for a Federal sanitary reserve corps, which would take care of the surroundings of camps and the civilian population contiguous thereto, is in Congress now, and has the unanimous support of the National Council of Defense. This may or may not go through, but even if it does it will operate too late to meet the emergency which we now face in Massachusetts.

To avoid disastrous conditions prompt action is necessary, and the sanitary organization should be placed in the field with the minimum of delay. There is no money available for such an extraordinary purpose in addition to the ordinary duties of the State Health Department. The work would require the full time of one District Health Officer, one assistant sanitary engineer, two sanitary inspectors, one food and drug inspector, three public health visiting nurses, and the staff and expenses of a small contagious disease hospital. A careful estimate of the cost of such an organization has been made, and $20,000 will be necessary for the period of one year.

In view of the fact that in the last analysis this is a Federal matter, an emergency obligation placed upon Massachusetts by Federal action, it seems reasonable that the Federal government would later take over the financing of such work and reimburse States for expenditures made. It would be a fatal blunder, however, to wait for Federal action to meet this menace and cover this emergency.

I have the honor, therefore, to recommend that the sum of $20,000, or such part thereof as may be necessary, be appropriated to be expended under the direction of the Commissioner of Health for the purpose of protecting the health of the people of Massachusetts and establishing and maintaining sanitary conditions in the area within a 15-mile radius of Ayer.

Respectfully,

A. J. McLaughlin,
Commissioner of Health.

Upon receiving the communication the Governor submitted the following message to the Legislature: —

Executive Department, Boston, May 21, 1917.

To the Honorable Senate and House of Representatives.

The Commissioner of Health has just called to my attention the importance of making immediate provision for the sanitary protection of the people within the towns upon the site of the camp proposed to be established by the national government in the Commonwealth, and of the towns in the vicinity of the camp. He calls attention to the fact that the camp will probably attract a large surplus population, many of whom will not be disposed to regard the law, and that conditions will suddenly spring up which should be dealt with immediately; otherwise we may undergo the experience of France and England, and suffer through the failure to provide a complete sanitary organization. I submit herewith a copy of the communication to which I have referred.

I therefore recommend that you make an appropriation of $20,000 to be expended by the Commissioner of Health, with the approval of the Governor and Council, to provide a complete sanitary organization for the area within the neighborhood of the camp and likely to be affected by its establishment, and otherwise to promote the health of the people within that locality.

I think it is doubtful whether the ordinary local constabulary or the machinery for enforcing the law existing within the small towns affected would be adequate to cope with the moral evils and sufficient to secure a due enforcement of existing law. I therefore recommend that if, in the opinion of the Governor and Council, the means of enforcing law within said area are not adequate or are not adequately employed, a supplementary force of the Commonwealth may be established for that purpose by the Governor with the advice of the Council in order to secure the due enforcement of the laws within such area, and I recommend the appropriation for that purpose of the sum of $10,000, or so much thereof as may be necessary to be expended by the Governor with the consent of the Council.

Samuel W. McCall.

In response to this message the following special act was passed by the Legislature: —

Special Acts, Chapter 369.

An Act making appropriations for expenses incident to the mobilization of troops in camps within the commonwealth.

Be it enacted, etc., as follows:

Section 1. The sums hereinafter mentioned are hereby appropriated, to be paid out of the treasury of the commonwealth from the ordinary revenue, for the following purposes:

For the protection of health, and the prevention of the spread of disease caused by the mobilization of troops in military camps, a sum not exceeding

twenty thousand dollars, to be expended by the commissioner of health, with the approval of the governor and council.

For the services and expenses of temporary detectives and police to be appointed by the governor and to act in conjunction with agents of the United States government in this commonwealth in preventing the evils incident to the mobilization of troops in military camps, a sum not exceeding ten thousand dollars, to be expended by the governor with the advice and consent of the council.

SECTION 2. This act shall take effect upon its passage. [*Approved May 25, 1917.*

The State Department of Health was asked by the town officials to direct the public health work in the various towns. An organization was formed composed of the executive members of the boards of health of the various towns, this body to act in conjunction with, and under the direction of, the two State District Health Officers assigned for duty in the zone. It is known as the Community Health Council. In this way uniformity in rules and regulations is secured.

In addition to the $20,000 furnished by the Legislature in response to the Governor's message, assistance has also been received from the Red Cross. They have added three nurses to our personnel and have furnished a first-aid equipment for accident cases.

As chairman of the Committee on Hygiene, Medicine and Sanitation I secured from the State Committee on Public Safety the installation of a comfort station at Ayer. The necessity for this is at once apparent when one considers that 150,000 visitors at the camp were not unusual on Sundays and holidays. This great number of visitors tends to increase the number of automobile and other accidents also, so that the first-aid station has been very useful.

The State Department of Health has established in the vicinity of Camp Devens a special sanitary district consisting of the towns within a 15-mile radius of Ayer, and has placed therein a sanitary organization which compares favorably with that of the most progressive cities.

There is a full-time District Health Officer in charge.

A food inspector who is a veterinarian.

A milk inspector and bacteriologist.

Five public health nurses.

A stenographer and clerk.

A sanitary engineer is detailed from the Department whenever necessary.

In the headquarters in Ayer we have a laboratory for milk and food analysis, and a first-aid station equipped by the Red Cross for accident and emergency cases.

To our nursing force may be added the local public health nurses in Ayer and other towns, and the combined public health nursing force covers the entire zone within 15 miles of Ayer.

According to our health laws in Massachusetts, local boards of health have very broad police power, while the power of the State Department of Health is very largely advisory. Accordingly, it was deemed wise to have our food inspector and our milk inspector appointed officially as local inspectors by the local boards of health. In this rather indirect way good results are being secured. Our nurses, working in co-operation with the local medical inspectors of schools, have perfected a very good system of inspection and follow-up work in school hygiene.

A system of garbage and refuse collection and disposal is being arranged for, and a sewerage system for the town of Ayer planned.

The State District Police and the special police of the State Committee on Social Conditions surrounding Training Camps are working in co-operation with this Department. We have furnished office room in our headquarters to police officials, social welfare workers and others. Lieut. Elmore M. McKee, S.C., U. S. N., was assigned to duty in the vicinity of the Ayer camp. I gave him office room in our headquarters. He is charged with the prevention of venereal disease in soldiers by co-operation with civilian health officials outside the camp limits. By having the various entities engaged in the work housed in our headquarters co-operation is secured and good results are being attained.

The zone itself has been maintained in good sanitary condition, and the efforts of the police in co-operation with our men have kept this area practically clear of prostitutes and liquor. Boston and Lowell are within easy access to the camp, as long leaves in excess of twenty-four hours are freely granted. Good work is being done in Lowell, and a campaign for elimination of vice is in progress in Boston. Results will be attained too slowly, however, to afford adequate protection to soldiers now at Ayer. Accordingly, the following letter was sent to the Surgeon-General of the army, recommending the curtailment of all leave in excess of three hours: —

Oct. 31, 1917.

Surgeon-General Gorgas, *United States Army, Washington, D. C.*

Sir: — The control and suppression of venereal disease in connection with the large military cantonment (Camp Devens) at Ayer, Mass., has been a matter of much concern to me, not only in so far as it may affect the health and life of the military forces, but also as it may affect the health of the civil population of this State.

In May of this year, when it became definitely known that such a camp would be established in Massachusetts, I took up with the Governor the matter of being prepared to formulate and carry out definite plans for the general sanitation of the district immediately contiguous to the camp. As a result of my representations the sum of $20,000 was appropriated for this purpose, to be expended under the direction of the Commissioner of Health, and an additional sum of $10,000 for the appointment of special police. As a result, our sanitary organization was in the field some time in advance of the arrival of the soldiers at the camp, and it has been found possible to maintain the area within a 15-mile radius of Ayer in good sanitary condition, and to a great extent to keep out of this area prostitutes and liquor.

The two largest cities near the camp, Boston (37 miles) and Lowell (18 miles), are, however, easily accessible from the camp, and present a very difficult problem in the control of venereal disease. After a careful study of present conditions in these two cities I am of the opinion that, in addition to measures already taken, the only prompt effective prophylactic measure which is feasible, and which would result in the prevention of a large amount of venereal disease, would be the curtailment of all leave in excess of three hours. I have discussed this problem with the Public Health Council of this Department, and they concur in this opinion. In other words, it is easier to keep soldiers out of Boston and Lowell at the present time than it is to eliminate vice from those cities.

This does not mean that strenuous measures to improve conditions in Boston and Lowell are unnecessary. On the contrary, there is great need for energetic work in the elimination of vice in all large cities, but any feasible measures in addition to those already taken within the power of civilian authorities would produce results too slowly to be of much value in protecting the soldiers stationed at Ayer under this draft.

A statement of this character, involving as it does recommendations for the army, coming from a civilian health officer, might be criticised as officious. I shall be sorry if such criticism is made, because the suppression of venereal disease is a complex problem, and the civilian health officer has a direct interest in the prevalence of venereal disease among soldiers because of its effect upon the civilian population both during and after the war.

As I have said, it is my earnest conviction that curtailment of all leave within excess of three hours is the most valuable prophylactic measure that could be instituted, and one which would be promptly effective in the reduction of venereal disease among the military and civil population, and I am writing to you in regard to this matter in the hope that you will take such steps as you may deem expedient to control the period of leave now granted to soldiers, in the interests of the public health.

Respectfully,

ALLAN J. MCLAUGHLIN,
Commissioner of Health.

As stated in my letter to Governor McCall the extraordinary measures necessary to secure and maintain sanitary conditions in the vicinity of Camp Devens should be paid for by the Federal government. The State Department of Health acted in an emergency to cover the period during which no Federal action was possible. The Federal government, through the United States Public Health Service, is now ready presumably to take over and finance this work. Appropriations were made by Congress in October, 1917, of $400,000 for the Public Health Service to carry out just such work.

Accordingly, on my suggestion, Governor McCall has requested the Federal government, through the Secretary of the Treasury, to take over and pay the expenses of all sanitary work in the extra-cantonment zone which is necessary in excess of the work done under normal conditions by the State and local health authorities. This will relieve the State of further extraordinary expenditures in the vicinity of Camp Devens. About $17,000 of the $20,000 appropriated will be turned back into the State treasury, and a bill presented to the Federal government for reimbursement for the amount expended by the Commonwealth in this emergency.

It is gratifying to note that the plan and method of handling the problem of the sanitation of the extra-cantonment zone at Ayer so promptly put into execution by the Department has been used as a model by the Federal government, and is being closely followed in other States.

The State Committee on Hygiene, Medicine and Sanitation.

The Massachusetts Committee on Public Safety appointed the Commissioner of Health as chairman of its Committee on Hygiene, Medicine and Sanitation. The Massachusetts Committee on Public Safety outlined its attitude toward official agencies, in its circular of instructions to chairmen of subcommittees, as follows: —

> We are merely acting as a representative citizen's committee whose task is not to grasp any authority but merely to help properly constituted national, State and city authorities in any way in our power, and possibly to fill here and there some gap not covered at present by any constituted authority.

It was deemed wise to prepare and stand ready to act in any field of hygiene, medicine and sanitation uncovered by official agencies. The Committee on Hygiene, Medicine and Sanitation took up directly and by means of subcommittees such questions as classification of medical personnel for service, suppression of venereal diseases, industrial

hygiene, child conservation, medical and surgical relief for the dependents of men in the service, and many other allied subjects.

These matters were discussed and investigated by the chairman to determine if they were being adequately covered by existing agencies. In most instances official departments were doing the work, and in some fields new agencies were already taking up the work suggested. The committee bridged over a gap during the time when the Red Cross was being organized for its great work of civilian relief, and has acted as a clearing house for all subjects related to hygiene, medicine and sanitation for the Massachusetts Committee on Public Safety.

The eight District Health Officers of the Department were appointed vice-chairmen in their respective districts of the Committee on Hygiene, Medicine and Sanitation, and did very valuable work in organizing local committees on hygiene, medicine and sanitation in the cities and towns in their districts.

Legislative Recommendations.

1. An act to promote the practice of school hygiene and the health and welfare of school children.
2. An act to provide for the physical examination of inmates of penal institutions.
3. An act increasing the powers and authority of analysts and chemists in the employ of the State Department of Health.
4. An act declaring reports and records of venereal diseases confidential.
5. An act regulating the sale and distribution of drugs, medicines or other substances purporting to be used for the cure or alleviation of venereal diseases.
6. An act providing for the further protection of the public health in the valley of the Neponset River.

Appropriations.

Regular.

The appropriations for the year ended Nov. 30, 1917, as recommended by the Commissioner of Health in the annual estimates made under the provisions of chapter 6, section 26, of the Revised Laws, were as follows: —

For the salary of the Commissioner of Health,	$7,500 00
For the general expenses of the Department,	17,000 00
For printing the annual report,	4,000 00

For the Division of Hygiene,		$20,000 00
For the salary of the director of the Division of Communicable Diseases,		4,000 00
For the salary and expenses of an epidemiologist,		3,000 00
For the State Inspectors of Health,		38,800 00
For the maintenance of a diagnostic laboratory,		6,500 00
For the production and distribution of antitoxin and vaccine,		33,500 00
For the prevention of ophthalmia neonatorum,		1,000 00
For the salary of the director of the Division of Food and Drugs,		3,500 00
For the inspection of food and drugs,		17,500 00
For slaughtering inspection and cold storage,		12,000 00
For water supply and sewage disposal,		56,800 00
For the State Examiners of Plumbers,		5,200 00
Total,		$230,300 00
Special Appropriations.		
For the prevention and suppression of syphilis, balance from 1916,	$8,890 91	
For the protection of health at military camp,	20,000 00	
For the examination of domestic water supplies,	2,500 00	
For the investigation of feasibility and cost of draining marshes along Neponset River and shores of Quincy Bay,	2,000 00	
		33,390 91
Emergency Appropriations. [1]		
For work in connection with child conservation,	$5,000 00	
For suppression of a nuisance in Eastham caused by decaying blackfish,	750 00	
For work in connection with the epidemic of infantile paralysis, balance from 1916,	4,577 08	
For after-care work in cases of infantile paralysis, balance from 1916,	4,776 12	
		15,103 20
Total,		$278,794 11

Expenditures.

The expenditures under the different appropriations for the year ended Nov. 30, 1917, were as follows: —

[1] Transferred by the Governor and Council from their appropriation for extraordinary expenses.

Regular Appropriations.

General Expenditures.

Appropriation,	$17,000 00
Salaries,	$8,878 70
Traveling,	645 14
Express,	200 95
Printing and binding,	562 28
Books and subscriptions,	196 46
Advertising,	30 94
Stationery, maps and blue prints,	435 02
Postage and postal orders,	1,690 58
Telephone and telegraph messages,	343 77
Typewriting supplies and repairs,	200 65
Sundry office supplies,	125 83
Health Council, per diem,	1,250 00
Extra services,	262 94
Messenger,	198 10
Miscellaneous,	72 26
Total,	$15,093 62
Unexpended balance,	1,906 38
	$17,000 00

Division of Hygiene.

Appropriation for the year ended Nov. 30, 1917,	$20,000 00
Credit on account of temporary increases,	27 09
	$20,027 09
Salaries,	$9,803 35
Traveling,	2,350 48
Express,	293 20
Printing and binding,	4,699 83
Books and subscriptions,	48 75
Advertising and educational work,	1,509 82
Stationery, maps and blue prints,	140 20
Postage,	452 26
Telephone and telegraph,	14 50
Typewriting supplies and repairs,	83 78
Extra services,	112 10
Office and laboratory supplies,	477 49
Miscellaneous,	41 33
Total,	$20,027 09

Expenditures for the Salary and Traveling Expenses of an Epidemiologist.

Appropriation for the year ended Nov. 30, 1917,	$3,000 00

Salaries,	$2,593 27
Traveling,	98 12
Printing,	30 55
Extra services,	50 00
Telephone and telegraph,	1 45
Maps and pins,	4 15
Postage,	100 00
Typewriting supplies,	81 00
Miscellaneous,	1 25
Total,	$2,959 79
Unexpended balance,	40 21
	$3,000 00

Expenses under the Provisions of the Act to provide for the Establishment of Health Districts and the Appointment of State Inspectors of Health (Chapter 537, Acts of 1907, Chapters 405 and 543, Acts of 1910, Chapters 603 and 609, Acts of 1911) for the Year ended Nov. 30, 1917.

Appropriation,	$38,800 00
Credit by cash returned to treasury,	2 38
Credit on account of temporary increases,	62 19
	$38,864 57

Salaries,	$28,708 40
Traveling,	7,096 16
Express,	15 02
Printing,	473 79
Books and maps,	64 20
Postage,	546 80
Typewriting supplies and rentals,	271 76
Extra services,	1,170 27
Telephone and telegraph,	344 94
Office supplies and stationery,	139 60
Laboratory and experimental work,	30 46
Miscellaneous,	3 17
Total,	$38,864 57

Expenditures for the Maintenance of a Diagnostic Laboratory for the Year ended Nov. 30, 1917.

Appropriation,	$6,500 00
Credit by check returned to treasury in settlement of damages by express company,	5 00
Credit on account of temporary increases,	41 67
	$6,546 67
Salaries,	$5,107 66
Laboratory supplies,	541 08
Printing,	341 52
Books and stationery,	42 15
Mailing cases,	372 36
Office supplies,	22 88
Traveling,	41 62
Purchase of animals,	58 50
Food for animals,	4 94
Miscellaneous,	10 05
Total,	$6,542 76
Unexpended balance,	3 91
	$6,546 67

Expenditures for the Production and Distribution of Antitoxin and Vaccine for the Year ended Nov. 30, 1917.

Appropriation,	$33,500 00
Credit by check returned to treasury in settlement of damages by express company,	1 00
Credit on account of temporary increases,	200 71
	$33,701 71
Salaries,	$16,343 63
Apparatus, chemicals and laboratory supplies,	5,572 97
Traveling,	218 42
Express,	116 35
Typewriting supplies, books and stationery,	234 58
Printing,	816 24
Purchase of animals,	1,365 64
Shipping,	1,166 88
Services of veterinary surgeon and saddlery,	41 00
Food for animals,	3,272 80
Rental of telephone, messages and postage,	236 24

Extra services,	$621 80
Water, gas, electric lighting and heating,	402 18
Labor and materials,	539 48
Ice,	224 79
Rent,	2,058 32
Miscellaneous,	345 74
Total,	$33,577 06
Unexpended balance,	124 65
	$33,701 71

For carrying out the Provisions of the Act relative to the Prevention of Ophthalmia Neonatorum (Chapter 458, Acts of 1910).

Appropriation for the year ended Nov. 30, 1917,	$1,000 00
Printing,	$4 53
Ophthalmia outfits,	970 24
Total,	$974 77
Unexpended balance,	25 23
	$1,000 00

Expenditures under the Provisions of the Food and Drug Acts for the Year ended Nov. 30, 1917.

Appropriation,	$17,500 00
Salaries,	$11,875 65
Apparatus and chemicals,	1,446 64
Traveling expenses,	2,608 43
Purchase of samples,	387 18
Express,	27 28
Printing,	229 64
Books, maps and stationery,	196 62
Telephone, telegraph messages and postage,	355 51
Sundry laboratory supplies,	120 24
Typewriting supplies and repairs,	64 10
Services (cleaning laboratory glassware),	145 75
Miscellaneous,	1 65
Total,	$17,458 69
Unexpended balance,	41 31
	$17,500 00

For carrying out the Provisions of the Act relative to Slaughtering Inspection and the Inspection of Food Products treated by Cold Storage.

Appropriation for the year ended Nov. 30, 1917,	$12,000 00
Credit on account of temporary increases,	40 78
	$12,040 78

Salaries,	$8,751 30
Traveling,	2,282 62
Express,	2 16
Printing,	176 77
Branding outfits,	25 82
Stationery and office supplies,	107 79
Telephone and telegraph,	23 17
Postage,	322 60
Extra services,	28 75
Typewriter supplies,	256 97
Purchase of samples,	57 88
Miscellaneous,	4 95
Total,	$12,040 78

For carrying out the Provisions of the Act to protect the Purity of Inland Waters, for the Examination of Sewer Outlets, and for the Examination of the Sanitary Condition of Certain Rivers and Water Courses.

Appropriation for the year ended Nov. 30, 1917,	$56,800 00
Credit by cash returned to treasury,	25 00
	$56,825 00

Salaries,	$42,481 82
Apparatus and materials,	3,462 55
Traveling,	4,305 70
Express,	1,280 61
Maps, blue prints and books,	159 54
Printing and binding,	673 06
Stationery, drawing materials and typewriting supplies,	545 12
Telephone and telegraph messages and postage,	335 16
Extra services,	55 75
Services, collecting samples and reading gauges,	426 73
Rent,	150 00
Miscellaneous,	192 82
Total,	$54,068 86
Unexpended balance,	2,756 14
	$56,825 00

State Examiners of Plumbers.

Appropriation,	$5,200 00

Salary of secretary,	$2,000 00
Examiner's wages,	603 25
Traveling,	459 66
Express,	30 31
Printing,	112 80
Postage,	141 86
Books and stationery,	46 07
Plumbers' materials,	50 54
Extra services,	1,134 99
Cleaning,	27 20
Office supplies,	9 00
Miscellaneous,	1 25
Telephone and lighting,	80 54
Typewriter supplies and repairs,	25 00
Labor and materials,	7 40
Total,	$4,729 87
Unexpended balance,	470 13
	$5,200 00

SPECIAL APPROPRIATIONS.

Expenditures under the Provisions of the Act for the Prevention and Suppression of Syphilis (Chapter 47, Resolves, 1916) for the Year ended Nov. 30, 1917.

Appropriation,	$10,000 00
Expended in 1916,	1,109 09
Balance,	$8,890 91

Salaries,	$1,851 38
Apparatus and chemicals,	1,736 56
Traveling,	32 00
Express,	3 62
Sundry laboratory supplies,	14 88
Extra services,	175 00
Purchase of animals,	9 20
Miscellaneous,	25
Total,	$3,822 89
Unexpended balance,	5,068 02
	$8,890 91

Expenditures under the Provisions of Chapter 369, Special Acts, 1917, for the Protection of Health at Military Camps.

Appropriation,	$20,000 00
Salaries,	$1,218 93
Traveling,	365 82
Express and trucking,	64 53
Stationery and typewriting supplies,	85 68
Telephone and telegraph,	34 31
Rent and lighting,	118 50
Extra services,	101 06
Printing,	44 41
Laboratory supplies and apparatus,	118 78
Cleaning,	51 50
Heating,	47 41
Miscellaneous,	69 71
Total,	$2,320 64
Unexpended balance, Nov. 30, 1917,	17,679 36
	$20,000 00

Expenditures under the Provisions of Chapter 90, Resolves, 1917, for the Examination of Domestic Water Supplies.

Appropriation,	$2,500 00
Traveling,	$6 10
Maps and blue prints,	9 22
Total,	$15 32
Unexpended balance,	2,484 68
	$2,500 00

Expenditures under the Provisions of Chapter 52, Resolves, 1917, for an Investigation of the Feasibility and Cost of draining the Marshes and Lowlands along the Neponset River and the Shores of Quincy Bay.

Appropriation,	$2,000 00
Salaries,	$1,385 39
Apparatus and materials,	4 50
Traveling,	38 56
Express,	7 80
Maps and blue prints, stationery,	16 88
Field equipment,	44 77

Telephone and telegraph,	$1 25
Extra services,	52 00
Miscellaneous,	3 53
Total,	$1,554 68
Unexpended balance, Jan. 8, 1918,	445 32
	$2,000 00

Emergency Appropriations.

For Work in Connection with Child Conservation.

Appropriation,	$5,000 00
Traveling,	$666 92
Telephone,	15 93
Extra services,	18 45
Miscellaneous,	8 20
Total,	$709 50
Unexpended balance returned to State treasury,	4,290 50
	$5,000 00

For Work in Connection with the Epidemic of Infantile Paralysis.

Appropriation,	$5,000 00
Expended in 1916,	422 92
Balance,	$4,577 08
Salaries,	$932 26
Traveling,	111 22
Telephone,	2 85
Total,	$1,046 33
Unexpended balance,	3,530 75
	$4,577 08

For Work in Connection with the After-care of Infantile Paralysis.

Appropriation,	$5,000 00
Expended in 1916,	223 88
Balance,	$4,776 12
Salaries,	$3,381 04
Traveling,	1,329 03
Express,	1 30
Telephone and telegraph,	17 82
Extra services,	35 00
Miscellaneous,	11 93
Total,	$4,776 12

RECAPITULATION.

Regular Appropriations.

	Appropriation.	Expended.
For the salary of the Commissioner of Health,	$7,500 00	$7,500 00
For the general expenses of the Department,	17,000 00	15,093 62
For printing the annual report,	4,000 00	4,316 44[1]
For the Division of Hygiene,	20,000 00	20,027 09[2]
For the salary of the director of the Division of Communicable Diseases,	4,000 00	4,000 00
For the salary and expenses of an epidemiologist,	3,000 00	2,959 79
For the State Inspectors of Health,	38,800 00	38,864 57[2]
For the maintenance of a diagnostic laboratory,	6,500 00	6,542 76[2]
For the production and distribution of antitoxin and vaccine,	33,500 00	33,577 06[2]
For the prevention of ophthalmia neonatorum,	1,000 00	974 77
For the salary of the director of the Division of Food and Drugs,	3,500 00	3,500 00
For the inspection of food and drugs,	17,500 00	17,458 69
For slaughtering inspection and cold storage,	12,000 00	12,040 78[2]
For water supply and sewage disposal,	56,800 00	54,068 86
For the State Examiners of Plumbers,	5,200 00	4,729 87
Totals,	$230,300 00	$225,654 30

Special Appropriations.

For the prevention and suppression of syphilis, balance from 1916,	$8,890 91	$3,822 89
For the protection of health at military camp,	20,000 00	2,320 64
For the examination of domestic water supplies,	2,500 00	15 32
For the investigation of feasibility and cost of draining marshes along Neponset River and shores of Quincy bay.	2,000 00	1,554 68
Totals,	$33,390 91	$7,713 53

Emergency Appropriations.

For work in connection with child conservation,	$5,000 00	$709 50
For suppression of a nuisance in Eastham caused by decaying blackfish,	750 00	750 00
For work in connection with the epidemic of infantile paralysis, balance from 1916.	4,577 08	1,046 33
For after-care work in cases of infantile paralysis, balance from 1916,	4,776 12	4,776 12
Totals,	$15,103 20	$7,281 95

[1] Balance, $316.44, transferred by the Governor and Council from their appropriation for extraordinary expenses.

[2] Credits by cash returned to the State treasury and allowance on account of temporary increases in salaries.

A. J. McLAUGHLIN,
Commissioner of Health.

SUPPLEMENT.

Division of Sanitary Engineering.

X. H. Goodnough, *Chief Engineer and Director.*

REPORT OF THE DIVISION OF SANITARY ENGINEERING.[1]

The duties of this Division relate chiefly to carrying out the requirements of the general law, which provides that the State Department of Health shall have the general oversight and care of inland waters of the Commonwealth, and the numerous special laws relating to that subject. Most important of the duties of the Department under these laws is that of consultation with and advice to cities, towns and persons relative to water supply, drainage, sewerage, the disposal of manufacturing waste and kindred subjects.

Owing to conditions produced by the war, public works construction has been restricted during the year to the completion of works already begun or the installation of such works as were indispensable, and, in consequence, the work of the Division with reference to water supply and sewerage construction and extension for cities and towns has been greatly restricted. On the other hand, much additional work has been required of this Division in connection with the water supply and sewerage of camps and hospitals. The work of the Division in connection with the disposal of manufacturing waste also has increased materially, mainly because of the difficulty of treating manufacturing wastes properly under existing conditions due to shortage of labor and supplies. All investigations relating to applications for the advice of the Department as to water supply and sewerage and the disposal of sewage and manufacturing wastes are carried out under the direction of the Engineering Division, and the more important recommendations of the Department in reply to applications for advice or for the approval of plans relating to water supply, drainage and sewerage will be found in a subsequent part of this report.

The total number of such applications received during the year was 147, of which 61 related to water supplies of cities and towns, 34 to well and spring water supplies, 7 to examinations of ice supply, 20 to sewerage, drainage and sewage disposal, 7 to the pollution of streams and 18 to miscellaneous matters.

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[1] A report of the doings of the Department under the general laws relating to the protection of inland waters, and under the numerous other general and special laws pertaining to that subject, as presented to the Legislature, will be found on pages 233 to 310.

Soon after the declaration of war a large part of the engineering force of the Department entered the service of the United States, and others engaged to take their places soon afterward left the Department for the same reason. Toward the end of the year it became impracticable to secure suitably qualified engineers, and the work of the Division has been seriously delayed in consequence.

In addition to the investigations referred to above, a large amount of consulting work is carried on directly with city and town officials, and with manufacturers and others, by the Engineer of the Division and his assistants.

The examination of water supplies and rivers and of sewer outlets and the effect of sewage disposal is also carried on under the direction of this Division, including the engineering work of the commission known as the Charles River Basin Approving Board, having the approval of all plans relating to sewerage works within the watershed of the Charles River Basin in the city of Boston. A number of special duties referred to the Department have been committed to this Division, including the improvement of the Neponset River, an investigation for the improvement of Hale's or River Meadow Brook in Lowell, the improvement of Aberjona River and Mystic Lakes (jointly with the Metropolitan Park Commission), for studies as to the prevention of the pollution of Boston Harbor and the recovery of valuable products from the sewage (jointly with the Division of Laboratories), studies with reference to the use of the summer flow of the Ipswich River for water supply purposes, and for examination of and advice concerning domestic water supplies.

Brief summaries of the work of this Division in relation to the examination of water supplies, water supply statistics, including rainfall and stream flow, and the examination of rivers and of sewage disposal works are appended hereto.

Examination of Water Supplies.

During the year over 300 sources of public water supply have been examined, and in most cases the sources have been inspected by members of the Engineering Division. The number of examinations has been restricted considerably on account of the lack of engineers properly trained for the purpose and chemists experienced in this work.

The following tables give the average results of chemical analyses of surface and ground water sources examined during the year: —

Averages of Chemical Analyses of Surface-water Sources for the Year 1917.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Hardness.
Metropolitan Water District.	Wachusett Reservoir, upper end,	.26	3.47	.0023	.0150	.0019	.28	1.0
	Wachusett Reservoir, lower end,	.15	3.42	.0025	.0125	.0018	.27	1.0
	Sudbury Reservoir,	.18	4.19	.0034	.0150	.0026	.30	1.1
	Framingham Reservoir No. 3,	.17	3.83	.0029	.0165	.0032	.31	1.2
	Hopkinton Reservoir,	.68	4.61	.0025	.0222	.0019	.40	1.1
	Ashland Reservoir,	.65	4.79	.0026	.0246	.0030	.35	1.2
	Framingham Reservoir No. 2,	.72	5.27	.0048	.0253	.0032	.43	1.2
	Lake Cochituate,	.20	6.56	.0044	.0239	.0048	.71	2.4
	Chestnut Hill Reservoir,	.17	3.76	.0023	.0151	.0026	.32	1.3
	Weston Reservoir,	.17	4.14	.0030	.0160	.0026	.31	1.2
	Spot Pond,	.09	3.71	.0019	.0163	.0027	.33	1.3
	Tap in State House,	.16	4.47	.0017	.0145	.0017	.32	1.4
	Tap in Revere,	.10	4.14	.0019	.0148	.0022	.33	1.3
	Tap in Quincy,	.15	4.06	.0010	.0126	.0018	.32	1.3
Abington,	Big Sandy Pond,	.09	4.00	.0033	.0129	.0010	.71	0.8
Adams,	Dry Brook,	.11	6.42	.0015	.0079	.0011	.14	6.3

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Hardness.
Adams — *Con.*	Bassett Brook,	.01	4.77	.0028	.0031	.0001	.11	3.2
Amherst,	Amethyst Brook large reservoir,	.35	4.07	.0016	.0115	.0012	.16	0.7
	Amethyst Brook small reservoir,	.19	3.77	.0039	.0109	.0026	.17	0.7
	Lower Reservoir,	.29	3.97	.0033	.0109	.0017	.17	0.8
Andover,	Haggett's Pond,	.15	4.71	.0026	.0169	.0017	.37	1.6
Ashburnham,	Upper Naukeag Lake,	.07	2.98	.0016	.0083	.0002	.14	0.4
Ashfield,	Bear Swamp Brook,	.35	4.95	.0015	.0137	.0021	.11	2.6
Athol,	Phillipston Reservoir,	.60	4.25	.0233	.0502	.0184	.20	0.8
	Buckman Brook Reservoir,	.17	3.41	.0048	.0156	.0040	.14	0.6
	Inlet of Filter,	.26	3.82	.0064	.0239	.0073	.14	0.8
	Outlet of Filter,	.31	3.45	.0055	.0237	–	.14	0.9
Barre,	Reservoir,	.17	4.00	.0063	.0175	.0021	.22	1.1
Blandford,	Freeland Brook,	.06	4.38	.0005	.0048	.0006	.19	1.8
Brockton,	Silver Lake,	.12	3.75	.0032	.0140	.0041	.63	0.9
Cambridge,	Lower Hobbs Brook Reservoir,	.13	6.15	.0050	.0247	.0032	.50	2.3
	Stony Brook Reservoir,	.36	6.46	.0071	.0245	.0052	.57	2.5
	Fresh Pond,	.23	7.01	.0081	.0301	.0093	.66	2.9
Cheshire,	Thunder Brook,	.00	7.52	.0006	.0040	.0007	.07	4.9
	Kitchen Brook,	.00	7.15	.0013	.0034	.0002	.09	5.3
Chicopee,	Morton Brook,	.06	4.34	.0015	.0046	.0006	.14	0.8
	Cooley Brook,	.30	5.35	.0075	.0144	.0038	.15	1.1
Colrain,	McClellan Reservoir,	.07	6.25	.0053	.0073	.0011	.13	3.9
Concord,	Nagog Pond,	.04	2.95	.0024	.0134	.0018	.36	0.9
Dalton,	Egypt Brook Reservoir,	.21	2.85	.0020	.0122	.0036	.11	0.9
	Cady Brook,	.24	4.57	.0018	.0147	.0007	.13	2.0
Danvers,	Middleton Pond,	.52	5.47	.0031	.0217	.0028	.42	1.6
Deerfield (South),	Roaring Brook,	.10	4.75	.0007	.0048	.0003	.15	3.0
Egremont (South),	Goodale Brook,	.03	5.40	.0000	.0020	.0002	.10	3.0
Fall River,	North Watuppa Lake,	.18	4.69	.0035	.0202	.0032	.60	0.9
Falmouth,	Long Pond,	.00	4.42	.0029	.0132	.0018	1.04	0.4
Fitchburg,	Meetinghouse Pond,	.08	3.17	.0053	.0146	.0020	.19	1.0
	Scott Reservoir,	.12	3.79	.0120	.0182	.0056	.25	0.7
	Wachusett Lake,	.09	3.11	.0054	.0135	.0021	.19	0.9

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Hardness.
Fitchburg — *Con.*	Falulah Brook,	.23	3.53	.0077	.0172	.0047	.21	0.6
	Ashby Reservoir,	1.02	4.59	.0231	.0420	.0130	.19	0.7
Gardner,	Crystal Lake,	.05	4.78	.0029	.0138	.0018	.32	1.9
Gloucester,	Dike's Brook Reservoir,	.32	4.12	.0035	.0153	.0019	.73	0.3
	Wallace Reservoir,	.47	4.62	.0027	.0200	.0046	.81	0.3
	Haskell Brook Reservoir,	.27	4.80	.0024	.0122	.0024	.79	0.3
Great Barrington,	East Mountain Reservoir,	.11	7.00	.0177	.0126	.0028	.15	4.1
	Green River,	.00	11.55	.0013	.0040	.0006	.13	9.6
Great Barrington (Housatonic).	Long Pond,	.11	8.52	.0044	.0201	.0019	.13	5.7
Greenfield,	Glen Brook Lower Reservoir,	.00	4.97	.0010	.0055	.0000	.15	2.9
Hadley,	Hart's Brook Reservoir,	.07	4.17	.0022	.0065	.0013	.19	1.8
Hatfield,	Running Gutter Brook Reservoir,	.15	4.50	.0052	.0122	.0019	.19	1.9
Haverhill,	Johnson's Pond,	.15	5.64	.0028	.0189	.0015	.48	2.2
	Crystal Lake,	.19	4.09	.0024	.0199	.0026	.37	1.3
	Kenoza Lake,	.18	5.22	.0021	.0188	.0019	.45	2.2
	Lake Saltonstall,	.10	6.86	.0088	.0194	.0034	.62	3.0
	Lake Pentucket,	.23	5.45	.0023	.0178	.0030	.46	2.1
	Millvale Reservoir,	.52	6.35	.0060	.0275	.0067	.41	2.1
Hingham,	Accord Pond,	.25	4.26	.0026	.0149	.0020	.68	0.7
Hinsdale,	Reservoir,	.16	2.62	.0021	.0131	.0020	.09	0.6
Holden,	Muschopauge Lake,	.03	2.87	.0016	.0124	.0017	.31	0.9
Holyoke,	Whiting Street Reservoir,	.10	5.01	.0040	.0141	.0020	.20	2.6
	Fomer Reservoir,	.29	4.26	.0028	.0110	.0016	.15	1.3
	Wright and Ashley Pond,	.11	5.70	.0041	.0179	.0034	.17	2.6
	High Service Reservoir,	.10	4.39	.0069	.0214	.0031	.20	1.6
	White Reservoir,	.28	4.36	.0145	.0212	.0066	.13	1.4
Hudson,	Gates Pond,	.13	4.03	.0041	.0165	.0020	.28	1.5
	Fosgate Brook,	.50	7.55	.0036	.0296	.0102	.20	2.6
Huntington,	Cold Brook Reservoir,	.11	2.35	.0006	.0052	.0006	.10	0.5
Ipswich,	Dow's Brook Reservoir,	.23	6.14	.0029	.0168	.0028	.82	2.1
Lawrence,	Merrimack River, filtered,	.36	5.95	.0042	.0088	-	.43	1.4
Lee,	Codding Brook Upper Reservoir,	.11	4.87	.0015	.0074	.0006	.12	1.9
	Codding Brook Lower Reservoir,	.09	4.63	.0032	.0072	.0010	.10	2.7

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Hardness.
Lee — *Con.*	Basin Pond Brook,	.36	5.02	.0023	.0134	.0022	.12	1.7
Lenox,	Reservoir,	.03	8.26	.0006	.0066	.0010	.11	6.6
Leominster,	Morse Reservoir,	.17	3.16	.0085	.0278	.0071	.18	0.4
	Haynes Reservoir,	.23	3.19	.0260	.0420	.0125	.19	0.4
	Fall Brook Reservoir,	.12	2.92	.0051	.0148	.0029	.22	0.6
Lincoln,	Sandy Pond,	.05	4.37	.0053	.0141	.0018	.39	1.6
Longmeadow,	Cooley Brook,	.07	5.00	.0037	.0074	.0021	.23	2.4
Lynn,	Birch Reservoir,	.18	5.35	.0075	.0251	.0027	.75	1.8
	Breed's Reservoir,	.28	5.99	.0084	.0246	.0037	.74	2.0
	Walden Reservoir,	.34	6.41	.0080	.0232	.0034	.77	2.4
	Hawkes Reservoir,	.42	6.61	.0075	.0290	.0045	.77	2.4
Manchester,	Gravel Pond,	.10	5.39	.0028	.0170	.0021	.93	1.2
Marlborough,	Lake Williams,	.06	5.37	.0039	.0171	.0026	.55	1.6
	Millham Brook Reservoir,	.50	5.76	.0069	.0255	.0050	.45	1.6
Maynard,	White Pond,	.17	3.70	.0013	.0129	.0017	.24	0.9
Milford,	Charles River, filtered,	.17	5.55	.0018	.0078	–	.39	1.8
Montague,	Lake Pleasant,	.02	2.92	.0035	.0082	.0019	.14	0.9
Nantucket,	Wannacomet Pond,	.12	7.67	.0038	.0183	.0059	2.24	1.4
New Bedford,	Little Quittacas Pond,	.46	4.53	.0043	.0240	.0031	.55	0.9
	Great Quittacas Pond,	.61	4.36	.0035	.0234	.0039	.52	0.7
North Adams,	Notch Brook Reservoir,	.01	6.55	.0034	.0058	.0010	.07	5.4
	Beaman Reservoir,	.02	6.92	.0039	.0116	.0027	.08	5.1
Northampton,	Middle Reservoir,	.17	4.61	.0028	.0121	.0020	.16	1.6
	Mountain Street Reservoir,	.11	4.09	.0028	.0082	.0015	.12	1.7
North Andover,	Great Pond,	.15	5.26	.0047	.0161	.0006	.48	1.8
Northborough,	Lower Reservoir,	.70	–	.0071	.0314	.0062	.32	1.3
Northbridge,	Cook Allen Reservoir,	.07	3.51	.0012	.0074	.0007	.21	0.7
North Brookfield,	Doane Pond,	.45	4.61	.0106	.0344	.0078	.19	1.0
	North Pond,	.48	4.40	.0061	.0317	.0087	.17	0.9
Northfield,	Reservoir,	.27	3.05	.0004	.0078	.0003	.15	1.0
Orange,	Reservoir,	.06	3.25	.0005	.0032	.0001	.13	0.9
Peabody,	Spring Pond,	.16	6.59	.0101	.0186	.0030	.81	2.4
	Suntaug Lake,	.05	5.02	.0083	.0168	.0034	.96	2.3

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Hardness.
				Free.	Albuminoid.			
					Total.	Suspended.		
Pittsfield, . .	Ashley Brook, ...	.26	5.58	.0049	.0170	.0015	.09	2.5
	Hathaway Brook, . . .	.07	8.60	.0038	.0095	.0028	.13	7.4
	Mill Brook, ...	.46	4.25	.0037	.0181	.0026	.10	1.9
	Sacket Brook, ...	.16	6.75	.0031	.0080	.0010	.11	5.5
	Farnham Reservoir, . . .	.57	4.52	.0049	.0225	.0034	.10	1.7
Plymouth, . .	Little South Pond, . . .	.00	2.86	.0038	.0221	.0031	.66	0.3
	Great South Pond, . . .	.00	2.90	.0051	.0169	.0016	.67	0.2
Randolph, . .	Great Pond, ...	.27	4.79	.0013	.0148	.0018	.57	0.8
Rockport, . .	Cape Pond, ...	.42	11.40	.0117	.0310	.0072	4.32	2.0
Russell, . . .	Black Brook, ...	.21	4.10	.0009	.0087	.0011	.16	1.4
Salem, . . .	Wenham Lake, ...	.35	7.49	.0126	.0291	.0084	.96	2.5
	Longham Reservoir, . . .	1.32	7.68	.0209	.0499	.0132	.84	1.7
Shelburne, . .	Fox Brook, ...	.04	5.82	.0002	.0039	–	.09	2.9
Southbridge, . .	Hatchet Brook Reservoir No. 3,	.19	3.06	.0048	.0197	.0046	.20	0.7
	Hatchet Brook Reservoir No. 4,	.22	3.22	.0091	.0213	.0043	.21	0.6
South Hadley, .	Leaping Well Reservoir, . .	.05	3.72	.0046	.0160	.0067	.21	0.9
	Buttery Brook Reservoir, . .	.14	4.53	.0070	.0105	.0025	.32	1.1
Spencer, . .	Shaw Pond, ...	.05	3.20	.0019	.0137	.0013	.20	1.0
Springfield, . .	Westfield Little River, filtered, .	.17	3.79	.0009	.0072	–	.13	1.2
Stockbridge, . .	Lake Averic, ...	.11	8.09	.0020	.0166	.0033	.10	5.5
Stoughton, . .	Muddy Pond Brook, . . .	.27	4.57	.0007	.0081	.0010	.40	1.2
Taunton, . .	Assawompsett Pond, . . .	.43	4.24	.0033	.0223	.0026	.54	0.7
	Elder's Pond, ...	.20	3.66	.0039	.0187	.0026	.54	0.6
Wakefield, . .	Crystal Lake, ...	.23	6.13	.0107	.0224	.0035	.86	1.9
Wareham (Onset), .	Jonathan Pond, ...	.01	3.42	.0006	.0095	.0020	.63	0.3
Wayland, . .	Snake Brook Reservoir, . .	.90	7.97	.0098	.0331	.0049	.43	2.2
Westfield, . .	Montgomery Reservoir, . .	.34	3.01	.0044	.0133	.0015	.13	0.5
	Tillotson Brook Reservoir, . .	.13	3.34	.0020	.0073	.0008	.15	0.7
West Springfield, .	Bear Hole Brook, filtered, . .	.13	7.71	.0035	.0077	–	.21	4.4
Weymouth, . .	Great Pond, ...	.75	3.88	.0027	.0182	.0029	.44	0.7
Williamsburg, .	Reservoir, ...	.17	4.30	.0014	.0093	.0017	.15	1.7
Winchester, . .	North Reservoir, ...	.07	4.00	.0052	.0153	.0017	.40	1.4
	South Reservoir, ...	.07	4.11	.0095	.0154	.0024	.42	1.4

Averages of Chemical Analyses of Surface-water Sources, etc. — Concluded.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Hardness.
Winchester — *Con.*	Middle Reservoir,	.13	3.96	.0066	.0215	.0043	.41	1.2
Worcester,	Bottomly Reservoir,	.20	3.98	.0039	.0158	.0024	.22	1.2
	Kent Reservoir,	.30	5.13	.0035	.0196	.0037	.29	1.6
	Leicester Reservoir,	.16	4.26	.0060	.0202	.0020	.24	1.2
	Mann Reservoir,	.17	4.72	.0026	.0181	.0029	.25	1.6
	Upper Holden Reservoir,	.13	3.18	.0031	.0135	.0025	.22	0.9
	Lower Holden Reservoir,	.12	3.24	.0030	.0133	.0016	.23	0.8

Averages of Chemical Analyses of Ground-water Sources for the Year 1917.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Hardness.	Iron.
Acton,	Tubular wells,	.00	9.31	.0005	.0015	.69	.1642	.0000	3.8	.004
Amesbury,	Tubular wells,	.26	16.03	.0030	.0031	.58	–	–	8.9	.223
Ashland,	Tubular wells,	.00	3.90	.0013	.0031	.41	–	–	1.6	.005
Attleboro,	Large well,	.04	5.37	.0004	.0053	.58	.0177	.0000	1.9	.010
Avon,	Wells,	.00	6.90	.0003	.0026	.66	.1908	.0001	2.5	.008
Ayer,	Large well,	.00	6.95	.0005	.0026	.57	.0733	.0000	2.7	.006
	Tubular wells,	.00	5.75	.0009	.0016	.26	.0125	.0000	2.1	.010
Barnstable,	Tubular wells,	.00	4.87	.0005	.0017	1.17	–	–	0.6	.017
Bedford,	Large well,	.03	4.22	.0009	.0051	.36	–	–	1.6	.030
Billerica,	Tubular wells,	.12	7.58	.0006	.0043	.40	–	–	2.5	.076
Braintree,	Filter-gallery,	.16	9.87	.0021	.0108	1.22	.2050	.0000	3.1	.011
Bridgewater,	Wells,	.00	5.47	.0003	.0016	.63	.0394	.0000	1.5	.019
Brookfield (East),	Tubular wells,	.00	2.95	.0003	.0012	.22	–	–	0.7	.005
Brookline,	Tubular wells and filter-gallery.	.22	9.60	.0069	.0062	.87	.0280	.0002	4.1	.060
	Tubular wells and filter-gallery filtered.	.19	9.27	.0004	.0079	.80	.0338	.0000	4.7	.021
Canton,	Springdale well,	.03	4.83	.0000	.0021	.43	.0087	.0000	1.3	.007
	Well near Henry's Spring,	.11	5.50	.0001	.0026	.54	.0227	.0000	1.7	.008

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as —		Hardness.	Iron.
				Free.	Albu-minoid.		Nitrates.	Nitrites.		
Chelmsford (North),	Tubular wells, . . .	.12	4.62	.0143	.0093	.43	.0280	.0001	1.9	.014
Chelmsford (Center),	Tubular wells, . . .	.00	8.74	.0006	.0016	.60	.1220	.0003	2.8	.011
Chicopee (Fairview),	Tubular wells, . . .	.00	5.30	.0004	.0021	.22	.0636	.0001	1.6	.016
Cohasset, . .	Tubular wells No. 2, . .	.18	13.60	.0004	.0102	1.95	.1200	.0001	5.0	.006
	Filtered water, . . .	.27	8.92	.0014	.0104	1.20	–	–	2.8	.031
Dedham, . .	Large well and tubular wells.	.05	10.46	.0023	.0061	1.08	.1325	.0001	4.4	.005
Deerfield (Fire District).	Wells, ...	.00	4.67	.0003	.0012	.14	.0020	.0000	2.6	.005
Douglas, . . .	Tubular wells, . . .	.00	5.47	.0007	.0011	.40	.0493	.0000	1.8	.036
Dracut (Water Supply District).	Tubular wells, . . .	.00	7.47	.0003	.0012	.52	.0887	.0000	3.5	.007
Dracut (Collinsville).	Tubular wells, . . .	.02	6.67	.0004	.0041	.34	–	–	2.6	.011
Dudley, . . .	Tubular wells, . . .	.00	4.23	.0005	.0021	.23	–	–	0.9	.004
Duxbury, . .	Tubular wells, . . .	.00	4.30	.0003	.0011	.89	.0122	.0000	0.7	.006
Easthampton, .	Tubular wells, . . .	.00	6.83	.0004	.0009	.15	.0287	.0000	4.0	.004
Easton, . . .	Well, ...	.00	5.07	.0004	.0018	.57	.0547	.0000	1.8	.009
Edgartown, . .	Large well, ...	.02	2.97	.0004	.0011	.96	–	–	0.2	.005
Fairhaven, . .	Tubular wells, . . .	.31	8.02	.0014	.0091	.99	.0555	.0000	2.5	.011
Foxborough, . .	Tubular wells, . . .	.00	5.23	.0001	.0006	.50	.0380	.0000	1.3	.007
Framingham, . .	Filter-gallery, . . .	.00	11.77	.0239	.0069	1.70	.0225	.0004	5.0	.009
Franklin, . .	Tubular wells, . . .	.00	4.60	.0007	.0023	.55	.0300	.0001	1.7	.007
Grafton, . .	Filter-gallery, . . .	.06	14.67	.0009	.0046	2.03	.2400	.0001	5.6	.007
Granville, . .	Well, ...	.00	3.90	.0010	.0040	.12	–	–	2.1	.005
Groton, . . .	Large well, ...	.01	6.35	.0002	.0029	.23	.0020	.0000	2.8	.012
Groton (West Groton Water Supply District).	Tubular wells, . . .	.00	5.33	.0006	.0009	.15	.0127	.0000	2.7	.005
Hingham, . .	Wells, ...	.45	6.18	.0043	.0109	.77	.0247	.0004	1.8	.019
Holliston, . .	Large well, ...	.59	4.93	.0009	.0151	.41	–	–	1.4	.165
Hopkinton, . .	Tubular wells, . . .	.02	11.53	.0008	.0023	1.08	.2800	.0002	5.0	.011
Kingston, . .	Tubular wells, . . .	.00	4.77	.0004	.0013	.76	–	–	1.1	.017
Leicester, . .	Wells, ...	.18	6.57	.0005	.0047	.40	–	–	2.3	.051
Leicester (Cherry Valley and Rochdale Water Supply District).	Wells, ...	.14	4.92	.0060	.0099	.31	–	–	2.2	.006
Littleton, . .	Tubular wells, . . .	.00	4.00	.0002	.0014	.21	–	–	1.6	.004
Lowell, . . .	Boulevard wells (tubular),	.40	6.70	.0389	.0072	.40	.0252	.0001	2.7	.233
Manchester, . .	Wells, ...	.00	11.87	.0002	.0009	2.03	.1517	.0000	3.8	.012

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as —		Hardness.	Iron.
				Free.	Albu-minoid.		Nitrates.	Nitrites.		
Mansfield,	Large well,	.00	4.17	.0011	.0016	.46	.0396	.0000	1.5	.009
Marion,	Tubular wells,	.00	4.35	.0005	.0015	.72	.0305	.0000	1.5	.005
Mattapoisett,	Tubular wells,	.00	6.60	.0004	.0012	.96	.0505	.0000	2.0	.055
Medfield,	Spring,	.00	4.25	.0006	.0029	.37	.0073	.0001	1.4	.010
Medway,	Tubular wells,	.00	7.93	.0010	.0023	.62	.0660	.0000	3.0	.002
Merrimac,	Tubular wells,	.00	6.57	.0004	.0012	.57	.0127	.0000	2.6	.013
Methuen,	Tubular wells,	.28	7.39	.0017	.0087	.50	.0200	.0001	2.8	.076
Middleborough,	Well,	–	7.69	.0059	.0080	.65	.0282	.0001	2.5	.261
	Filtered water,	.13	6.62	.0006	.0047	.64	.0347	.0000	2.4	.030
Millbury,	Well,	.05	5.10	.0020	.0034	.36	–	–	1.9	.020
Millis,	Spring,	.00	10.40	.0005	.0013	.79	.2600	.0001	4.3	.006
Monson,	Large well,	.08	3.30	.0005	.0045	.19	–	–	0.8	.015
Natick,	Large well,	.00	9.40	.0006	.0026	.81	.0325	.0000	4.6	.006
Needham,	Wells,	.00	7.06	.0002	.0019	.74	.0948	.0000	2.6	.010
	Hicks Spring,	.01	7.37	.0008	.0030	.82	.2080	.0000	2.4	.008
Newburyport,	Wells and Artichoke River filtered.	.21	7.40	.0036	.0132	.70	.0217	.0001	2.8	.041
Newton,	Tubular wells and filter-gallery.	.01	7.20	.0003	.0025	.56	.0474	.0001	2.8	.008
No. Attleborough,	Wells,	.02	6.30	.0006	.0014	.58	.0330	.0001	2.5	.008
Norton,	Tubular wells,	.00	4.30	.0003	.0008	.39	–	–	1.3	.005
Norwood,	Tubular wells,	.21	10.18	.0022	.0072	.62	.0385	.0001	4.3	.065
Oak Bluffs,	Springs,	.00	4.52	.0008	.0014	.99	.0162	.0000	0.7	.005
Oxford,	Tubular wells,	.00	4.67	.0001	.0008	.35	.0480	.0000	1.7	.004
Palmer (Bondsville),	Tubular wells,	.00	5.43	.0006	.0022	.22	.0222	.0000	2.1	.003
Pepperell,	Tubular wells,	.00	3.82	.0001	.0012	.21	–	–	1.2	.005
Plainville,	Tubular wells,	.01	4.37	.0002	.0012	.35	–	–	2.1	.016
Provincetown,	Tubular wells in Truro,	.01	14.12	.0002	.0012	5.39	–	–	3.0	.015
Reading,	Filter-gallery,	.52	13.43	.0217	.0131	1.67	.0090	.0006	3.2	.466
	Filtered water,	.11	16.95	.0006	.0061	1.09	.0099	.0002	7.1	.020
Salisbury,	Well,	.11	9.56	.0007	.0033	.59	–	–	4.5	.019
Scituate,	Tubular wells,	.00	15.13	.0001	.0019	3.33	.2367	.0001	5.3	.005
Sharon,	Well,	.02	15.40	.0002	.0010	2.03	.0322	.0000	6.0	.007
	Tubular wells,	.00	5.63	.0003	.0010	.49	.0430	.0000	2.0	.005
Sheffield,	Spring,	.00	3.80	.0005	.0020	.09	.0020	.0001	2.1	.005

Averages of Chemical Analyses of Ground-water Sources, etc. — Concluded.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as —		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Shirley, . . .	Well, ...	.00	4.70	.0004	.0011	.46	.1350	.0000	1.3	.006
Shrewsbury, . .	Wells, ...	.00	5.55	.0002	.0013	.49	.0437	.0000	1.6	.006
South Hadley (Fire District No. 2).	Large well, ...	.00	4.17	.0003	.0014	.16	.0370	.0000	1.3	.005
Tisbury, . . .	Well, ...	.00	5.77	.0005	.0019	.98	-	-	0.6	.004
Uxbridge, . .	Tubular wells, ...	.00	6.07	.0004	.0027	.57	.0652	.0000	1.9	.007
Walpole, . . .	Tubular wells, ...	.00	5.67	.0001	.0016	.45	.0360	.0000	1.9	.025
Waltham, . .	Old well, ...	.14	9.30	.0045	.0038	.84	.0190	.0000	4.0	.071
	New well, ...	.00	8.04	.0008	.0037	.64	.0197	.0001	4.0	.005
Ware, ...	Wells, ...	.00	7.17	.0001	.0012	.46	.1533	.0001	2.3	.005
Wareham (Fire District).	Tubular wells, ...	.00	3.75	.0005	.0011	.60	-	-	0.6	.006
Warren (West), .	Large well, ...	.00	5.12	.0008	.0014	.18	.0110	.0000	1.9	.006
Webster, . .	Wells, ...	.01	4.10	.0015	.0051	.34	.0153	.0000	1.5	.007
Wellesley, . .	Tubular wells, ...	.00	9.98	.0006	.0021	1.15	.0605	.0000	4.3	.007
	Well at Williams Spring, .	.00	15.65	.0017	.0027	1.30	.5200	.0001	5.8	.005
	Filter-gallery, ...	.00	9.62	.0039	.0035	1.10	.0807	.0000	4.4	.007
Westborough, . .	Filter basin, ...	.02	3.07	.0033	.0098	.29	-	-	1.1	.008
West Brookfield, .	Tubular wells, ...	.00	5.30	.0006	.0019	.26	.0332	.0000	1.4	.003
Westford, . .	Tubular wells, ...	.00	4.50	.0006	.0013	.18	-	-	1.7	.009
Weston, . . .	Well, ...	.07	7.79	.0011	.0044	.61	.0456	.0000	3.0	.007
Winchendon, . .	Wells, ...	.05	3.66	.0020	.0026	.15	-	-	0.9	.156
Woburn, . .	Filter-gallery, ...	.00	12.14	.0015	.0038	1.52	.0324	.0001	5.3	.004
Worthington, . .	Springs, ...	.00	3.57	.0008	.0047	.09	-	-	2.1	.007
Wrentham, . .	Tubular wells, ...	.00	4.15	.0003	.0013	.41	.0667	.0000	1.3	.012

Water Supply Statistics, also Records of Rainfall and Flow of Streams.

During the year 1917 there was very little water works construction and no new public water supplies were introduced. Of the 354 cities and towns in Massachusetts, 212, including all of the 37 cities and 175 of the towns, are provided with public water supplies. The following table gives a classification by population of the cities and towns having and not having public water supplies at the end of the year: —

Population (1915).	Number of Places of Given Population having Public Water Supplies.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having Public Water Supplies.	Total Population of Places in Preceding Column.
Under 500,	-	-	40	13,270
500-999,	7	5,229	36	27,536
1,000-1,499,	21	27,759	24	29,589
1,500-1,999,	12	21,685	20	33,947
2,000-2,499,	17	37,819	10	22,002
2,500-2,999,	20	54,895	6	16,013
3,000-3,499,	6	19,928	3	9,920
3,500-3,999,	8	30,123	-	-
Above 4,000,	121	3,329,981	3	13,614
Totals,	212	3,527,419	142	165,891

The 212 cities and towns having public water supplies are classified in the following table according to the dates when a fairly complete system of water supply was first introduced: —

Years.	Number of Public Water Supplies introduced.	Years.	Number of Public Water Supplies introduced.
Previous to 1850,	5	1890-1899, inclusive,	34
1850-1859, inclusive,	4	1900-1909, inclusive,	21
1860-1869, inclusive,	9	1910-1917, inclusive,	24
1870-1879, inclusive,	45	Total,	212
1880-1889, inclusive,	70		

The first table presented shows that although but 60 per cent. of the cities and towns in the State are provided with public water supplies, the total population of the places supplied is 96 per cent. of the total population of the State. The populations given in this table were obtained by using the total population of the cities and towns supplied, and is somewhat greater than the actual number of persons to whom the public water supply is available, but the difference is not great. With the exception of the town of Tewksbury, all of the towns in the State having a population in excess of 5,000 are now supplied with water, and there are only 12 towns having a population in excess of 2,500 which are not provided with public water supplies. These towns are as follows: —

Town.	Population.	Town.	Population.
Tewksbury,	5,265	Sutton,	2,829
Warren,	4,268	Seekonk,	2,767
Templeton,	4,081	Bourne,	2,672
Somerset,	3,377	Hanover,	2,666
Auburn,	3,281	Swansea,	2,558
Westport,	3,262	Wilbraham,	2,521

At the present time the water works are owned either by the municipality or by a water, water supply or fire district in all of the cities and 133 of the towns, while in 43 towns the works are owned by private companies. The following table gives the classification by population of the cities and towns which own their water works and those which are supplied with water by private companies: —

Population in 1915.	Cities and Towns owning Water Works.		Cities and Towns supplied with Water by Private Companies.	
	Number.	Total Population.	Number.	Total Population.
Under 1,000,	3	1,901	4	3,328
1,000–1,999,	23	33,846	10	15,598
2,000–2,999,	28	69,407	9	23,307
3,000–3,999,	8	28,942	6	21,109
4,000–4,999,	7	31,251	2	9,476
5,000–5,999,	16	88,166	3	16,117
6,000–6,999,	10	66,316	3	18,778
7,000–7,999,	7	52,937	–	–
Over 8,000,	67	2,979,893	6	67,047
Total,	169	3,352,659	43	174,760

The tendency toward municipal ownership of water works is shown in the following table, giving, for the census years since 1890, the total population of all cities and towns supplied with water and the total population of those supplied by private companies with its percentage of the total population of all places supplied: —

Year.	Total Population of All Cities and Towns provided with Public Water Supplies.	Population of Towns supplied by Private Companies.	Per Cent. of Total Population supplied with Water.
1890,	1,924,812	318,319	16.5
1895,	2,237,017	212,579	9.5
1900,	2,565,301	236,869	9.2
1905,	2,792,490	193,290	6.9
1910,	3,171,055	159,730	5.0
1915,	3,528,769	174,760	5.0

The foregoing table shows that the total population of the towns supplied with water by private companies is only 5 per cent. of the total population of all the cities and towns supplied with water, and there are only 12 towns having a population in excess of 5,000 which are supplied by private companies. These towns are as follows: —

Town.	Population (1915).	Town.	Population (1915).
Southbridge,	14,217	Fairhaven,	6,277
Milford,	13,684	Ludlow,	6,251
Dedham,	11,043	Grafton,	6,250
Palmer,	9,468	Amherst,	5,558
Bridgewater,	9,381	Millbury,	5,295
Northbridge,	9,254	Hingham,	5,264

In the annual report of the State Department of Health for the year 1915 (pages 296 to 306) there was presented a table showing the population and valuation of all of the cities and towns in Massachusetts in 1915, together with certain other information relative to the ownership of the water works and the date of their introduction into those places so provided.

Consumption of Water.

Records of the consumption of water are kept in nearly all of the cities and towns where water is pumped, and in several places supplied by gravity, Venturi meters have been installed to measure the consumption.

The following table gives statistics with regard to the consumption of water in the year 1917 in those cities and towns from which records could be obtained. The populations given in the table were obtained by adding two-fifths of the increase in population between 1910 and 1915 to the population as determined by the census of the latter year. The daily consumption of water per inhabitant has been obtained by dividing the average daily consumption by the estimated total population of the city or town in 1917. The quantity obtained in this manner is somewhat less than the actual consumption per person using the water, because there are in all cities and towns a greater or less number of persons who do not use the public supply. The difference between the number of inhabitants and the number of consumers would account, to a large extent, for the low rate per inhabitant in some of the towns which contain villages to which the public water supply has not been extended, and in towns where the works have been in operation but a short time, and where, in consequence, water has not come into general use. In some towns the population during the summer months is much greater than is shown by the census returns, and in such cases the consumption per inhabitant as given in the table is higher than it would be if allowance were made for the increased population in the summer. With a few exceptions, however, the difference between the census returns and the actual population supplied is not great.

Consumption of Water in Various Cities and Towns in 1917.

City or Town.	Estimated Population.	Average Daily Consumption.		City or Town.	Estimated Population.	Average Daily Consumption.	
		Gallons.	Gallons per Inhabitant.			Gallons.	Gallons per Inhabitant.
Metropolitan Water District:[1] —	1,253,719	113,153,000	90	Metropolitan Water District — *Con.*			
Arlington, .	16,370	997,000	61	Everett, .	39,412	3,033,000	77
Belmont, . .	9,097	475,000	52	Lexington, .	5,786	427,000	74
Boston, . .	769,178	82,073,000	107	Malden, . .	50,708	2,419,000	48
Chelsea, .	47,816	3,189,000	67	Medford, .	33,453	1,641,000	49

[1] Including Newton, which is within the District, but supplied from independent works.

Consumption of Water in Various Cities and Towns in 1917 — Continued.

City or Town.	Estimated Population.	Average Daily Consumption. Gallons.	Gallons per Inhabitant.	City or Town.	Estimated Population.	Average Daily Consumption. Gallons.	Gallons per Inhabitant.
Metropolitan Water District — *Con.*				Duxbury,	2,014	59,000	29
MELROSE,	17,346	903,000	52	East Bridgewater,	3,819	121,000	32
Milton,	8,870	375,000	42	Easthampton,	10,373	739,000	71
Nahant,	1,468	155,000	106	East Longmeadow,	2,093	27,000	13
QUINCY,	43,887	2,707,000	62	Easton,	5,034	150,000	30
REVERE,	27,962	1,615,000	58	Fairhaven,	6,739	277,000	41
SOMERVILLE,	90,701	6,676,000	74	FALL RIVER,	126,989	6,346,000	50
Stoneham,	7,649	531,000	69	Falmouth,	4,226	373,000	88
Swampscott,	7,801	504,000	65	FITCHBURG,	40,388	4,100,000	102
Watertown,	17,971	1,585,000	88	Foxborough,	3,712	217,000	58
Winthrop,	13,808	727,000	53	Framingham,	17,025	1,069,000	63
Abington and Rockland.	12,855	630,000	49	Franklin,	6,760	334,000	49
Agawam,	4,977	106,000	21	Gardner,	17,047	768,000	45
Amesbury,	8,003	578,000	72	GLOUCESTER,	24,510	1,427,000	58
Andover,	8,249	597,000	72	Grafton,	6,468	190,000	29
Ashland,	2,134	46,000	22	Groton,	2,404	123,000	51
ATTLEBORO,	19,386	1,086,000	56	Holliston,	2,819	83,000	29
Avon,	2,224	89,000	40	HOLYOKE,	62,050	6,338,000	102
Ayer,	2,772	282,000	102	Hudson,	6,764	304,000	45
Barnstable,	5,123	137,000	27	Ipswich,	6,470	328,000	51
Bedford,	1,419	46,000	32	Lancaster,	2,633	74,000	28
BEVERLY,	24,683	1,611,000	65	LAWRENCE,	92,006	4,069,000	44
Billerica,	3,429	384,000	112	Lenox,	3,315	270,000	81
Braintree,	9,854	588,000	60	Lincoln,	1,364	219,000	161
Bridgewater,	10,058	213,000	21	Littleton,	1,228	41,000	33
BROCKTON,	64,452	2,573,000	40	Longmeadow,	2,061	86,000	42
Brookline,	35,769	3,078,000	86	LOWELL,	108,652	6,480,000	60
CAMBRIDGE,	110,415	9,712,000	88	Ludlow,	6,772	223,000	33
Canton,	5,953	296,000	50	LYNN and Saugus,	109,487	7,316,000	67
Chelmsford,	5,251	111,000	21	Manchester,	3,054	432,000	141
Clinton,	13,239	599,000	45	Mansfield,	6,008	655,000	109
Concord,	6,785	524,000	77	Marblehead,	7,713	557,000	72
Danvers and Middleton.	13,265	1,558,000	117	Marion,	1,498	90,000	60
Dedham,	11,747	1,041,000	89	MARLBOROUGH,	15,518	633,000	41
Dudley,	4,415	124,000	28	Mattapoisett,	1,400	48,000	34

Consumption of Water in Various Cities and Towns in 1917 — Concluded.

City or Town.	Estimated Population.	Average Daily Consumption.		City or Town.	Estimated Population.	Average Daily Consumption.	
		Gallons.	Gallons per Inhabitant.			Gallons.	Gallons per Inhabitant.
Maynard,	6,922	358,000	52	Rockport,	4,407	240,000	54
Medway,	2,906	122,000	42	Salem,	46,500	4,758,000	102
Merrimac,	2,061	102,000	49	Salisbury,	1,741	76,000	44
Methuen,	15,031	854,000	57	Sharon,	2,531	152,000	60
Middleborough,	8,798	408,000	46	Shirley,	2,296	75,000	33
Milford and Hopedale.	16,789	748,000	45	Shrewsbury,	3,133	50,000	16
Millbury,	5,517	241,000	44	Southbridge,	14,867	686,000	46
Montague and Erving.	9,525	682,000	72	Springfield,	109,089	11,860,000	109
Nantucket,	3,248	208,000	64	Stoughton,	7,248	369,000	51
Natick,	11,620	634,000	55	Taunton,	36,922	2,792,000	76
Needham,	7,148	379,000	53	Tisbury,	1,375	136,000	99
New Bedford,	114,734	9,249,000	81	Wakefield,	13,332	554,000	42
Newburyport,	15,456	1,202,000	78	Walpole,	5,729	961,000	168
Newton,	44,436	3,121,000	70	Waltham,	31,082	2,249,000	72
North Andover,	6,127	353,000	58	Ware,	9,575	453,000	47
North Attleborough,	9,332	344,000	37	Wareham,	5,606	152,000	27
North Brookfield,	2,896	227,000	78	Webster,	12,987	639,000	49
Norton,	2,604	100,000	38	Wellesley,	6,849	544,000	79
Norwood,	12,162	1,284,000	106	West Bridgewater,	2,945	85,000	29
Oak Bluffs,	1,309	166,000	127	West Brookfield,	1,272	35,000	28
Orange,	5,418	137,000	25	Westfield,	19,358	2,262,000	117
Peabody,	19,787	3,304,000	167	Westford,	2,840	121,000	43
Pepperell,	2,793	133,000	48	Weston,	2,436	137,000	56
Pittsfield,	42,601	5,786,000	136	Weymouth,	14,399	1,127,000	78
Plainville,	1,417	30,000	21	Whitman,	7,611	214,000	28
Plymouth,	13,240	1,294,000	98	Woburn,	16,851	2,046,000	121
Provincetown,	4,265	259,000	61	Worcester,	169,381	15,260,000	90
Randolph and Holbrook.	7,908	435,000	55	Wrentham,	2,682	122,000	45
Reading,	7,200	249,000	35				

Rainfall.

The normal yearly rainfall in Massachusetts as deduced from long-continued observations in various parts of the State is 44.54 inches. The average rainfall for the year 1917 in these places was 40.23 inches, a deficiency of 4.31 inches. The year was the fourteenth in succession in which the rainfall has been less than the normal, the accumulated

deficiency at the end of the year being 53.42 inches, or 8.88 inches more than the total rainfall in a normal year. There was an excess of precipitation in the months of March, May, June, August and October, and a deficiency in the other seven months of the year. The greatest excess in any month occurred in October, when the average rainfall was 5.68 inches, or 1.85 inches greater than the normal; the greatest deficiency occurred in November, when the average rainfall was 0.89 of an inch, or 2.92 inches less than the normal.

The following table gives the normal rainfall in the State for each month as deduced from observations at various places for a long period of years, together with the average rainfall at those places for each month during the year 1917 and the departure from the normal: —

Month.	Normal Rainfall (Inches).	Rainfall in 1917 (Inches).	Excess or Deficiency in 1917 (Inches).	Month.	Normal Rainfall (Inches).	Rainfall in 1917 (Inches).	Excess or Deficiency in 1917 (Inches).
January,	3.73	3.14	—0.59	August,	4.25	5.86	+1.61
February,	3.61	2.60	—1.01	September,	3.40	1.73	—1.67
March,	3.90	4.31	+0.41	October,	3.83	5.68	+1.85
April,	3.59	2.51	—1.08	November,	3.81	0.89	—2.92
May,	3.69	4.40	+0.71	December,	3.68	2.69	—0.99
June,	3.25	4.63	+1.38	Total,	44.54	40.23	—4.31
July,	3.80	1.79	—2.01				

Flow of Streams.

Sudbury River.

The average flow of the Sudbury River during the year 1917 was 750,000 gallons per day per square mile of drainage area, or about 77 per cent. of the normal flow for the past forty-three years. The flow was in excess of the normal in the months of May, June and October, but less than the normal in the other nine months of the year. The greatest excess occurred in the month of June, and the greatest deficiency in the month of February. The average flow for the driest six months, July to December, inclusive, was 267,000 gallons per day per square mile, or 70 per cent. of the normal flow for such period during the past forty-three years.

In order to show the relation between the flow of the Sudbury River during each month of the year 1917 and the normal flow of that stream, as deduced from observations during forty-three years, from 1875 to 1917, inclusive, the following table has been prepared. The drainage area of the Sudbury River above the point of measurement is 75.2 square miles.

Table showing the Average Daily Flow of the Sudbury River for Each Month in the Year 1917, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1917.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January,	1.816	1.174	0.789	0.510	—1.027	—0.664
February,	2.560	1.655	1.168	0.755	—1.392	—0.900
March,	4.175	2.699	3.417	2.209	—0.758	—0.490
April,	3.075	1.987	2.174	1.405	—0.901	—0.582
May,	1.661	1.073	2.283	1.476	+0.622	+0.403
June,	0.770	0.498	1.615	1.044	+0.845	+0.546
July,	0.280	0.181	0.066	0.043	—0.214	—0.138
August,	0.376	0.243	0.313	0.202	—0.063	—0.041
September,	0.329	0.213	0.090	0.058	—0.239	—0.155
October,	0.638	0.413	0.746	0.482	+0.108	+0.069
November,	1.126	0.728	0.678	0.438	—0.448	—0.290
December,	1.462	0.945	0.589	0.380	—0.873	—0.565
Average for whole year,	1.517	0.980	1.161	0.750	—0.356	—0.230

In the annual report of the State Department of Health for the year 1915 (pages 312 to 318) tables were presented giving the record of the rainfall upon the drainage area of the Sudbury River and the yield expressed in inches in depth upon the drainage area (inches of rainfall collected) for each of the forty-one years, from 1875 to 1915, inclusive. The corresponding record for the years 1916 and 1917, together with the average for the entire period of forty-three years, is given in the following table: —

Rainfall, in Inches, received and collected on the Sudbury River Drainage Area.

Month.	1916.			1917.			Mean for Forty-three Years, 1875–1917.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January,	1.53	1.680	109.8	3.50	0.909	25.9	4.06	2.094	51.6
February,	5.91	2.262	38.2	2.68	1.216	45.5	4.13	2.688	65.2
March,	4.16	3.245	78.1	4.96	3.940	79.4	4.36	4.815	110.3
April,	4.19	5.243	125.1	2.41	2.425	100.5	3.54	3.431	96.9
May,	3.43	2.567	74.9	4.93	2.632	53.4	3.32	1.915	57.6
June,	4.77	2.068	43.4	4.23	1.802	42.7	3.09	0.859	27.8
July,	5.17	1.044	20.2	1.11	0.076	6.8	3.63	0.322	8.9
August,	2.01	0.139	6.9	6.40	0.361	5.6	3.91	0.433	11.1
September,	1.80	0.044	2.5	1.52	0.100	6.6	3.25	0.367	11.3
October,	1.49	—0.009	—0.6	5.65	0.860	15.2	3.83	0.736	19.2
November,	2.28	0.189	8.3	1.31	0.757	57.6	3.67	1.256	34.2
December,	3.22	0.562	17.4	2.81	0.678	24.2	3.81	1.686	44.3
Totals and averages,	39.96	19.034	47.6	41.51	15.756	38.0	44.60	20.602	46.2

The following table gives the record of the yield of the drainage area of the Sudbury River for each of the past forty-three years, the flow being expressed in gallons per day per square mile of drainage area in order to render the table more convenient for use in estimating the probable yield of drainage areas used as sources of water supply: —

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile.[1]

Month.	1875.	1876.	1877.	1878.	1879.	1880.
January,	103,000	643,000	658,000	1,810,000	700,000	1,121,000
February,	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000
March,	1,604,000	4,435,000	4,813,000	3,507,000	2,330,000	1,374,000
April,	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,168,000
May,	1,188,000	1,139,000	1,391,000	1,394,000	1,114,000	514,000
June,	870,000	222,000	597,000	506,000	413,000	176,000
July,	321,000	183,000	202,000	128,000	158,000	177,000
August,	396,000	405,000	121,000	475,000	395,000	119,000
September,	207,000	184,000	60,000	160,000	141,000	80,000
October,	646,000	234,000	632,000	516,000	71,000	101,000
November,	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000
December,	584,000	454,000	1,289,000	3,177,000	462,000	175,000
Average for whole year,	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000
Average for driest six months,	574,000	384,000	502,000	532,000	230,000	143,000

[1] The drainage area of the Sudbury River used in making up these records included water surfaces amounting to about 2 per cent. of the whole area, from 1875 to 1878 inclusive, subsequently increasing by the construction of storage reservoirs to about 3 per cent. in 1879, to 3.5 per cent. in 1885, to 4 per cent. in 1894 and to 6.5 per cent. in 1898. The drainage area also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile — Continued.

MONTH.	1881.	1882.	1883.	1884.	1885.	1886.
January,	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000
February,	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,800,000
March,	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000
April,	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000
May,	965,000	1,292,000	938,000	1,030,000	1,336,000	720,000
June,	1,338,000	529,000	300,000	417,000	426,000	203,000
July,	276,000	86,000	115,000	224,000	62,000	115,000
August,	148,000	55,000	78,000	257,000	240,000	94,000
September,	197,000	306,000	91,000	44,000	121,000	118,000
October,	186,000	299,000	186,000	83,000	336,000	146,000
November,	395,000	210,000	205,000	175,000	1,178,000	673,000
December,	775,000	314,000	193,000	925,000	1,174,000	1,020,000
Average for whole year,	979,000	862,000	533,000	1,129,000	901,000	1,087,000
Average for driest six months,	330,000	211,000	145,000	200,000	391,000	223,000

MONTH.	1887.	1888.	1889.	1890.	1891.	1892.
January,	2,589,000	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000
February,	2,829,000	1,951,000	1,195,000	1,529,000	3,486,000	943,000
March,	2,868,000	3,237,000	1,339,000	3,643,000	4,453,000	1,955,000
April,	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000	871,000
May,	1,009,000	1,632,000	880,000	1,366,000	582,000	1,259,000
June,	414,000	422,000	653,000	568,000	414,000	428,000
July,	114,000	117,000	633,000	108,000	149,000	214,000
August,	214,000	380,000	1,432,000	132,000	163,000	280,000
September,	111,000	1,155,000	824,000	458,000	203,000	229,000
October,	190,000	1,999,000	1,230,000	2,272,000	210,000	126,000
November,	368,000	2,758,000	1,941,000	1,215,000	305,000	697,000
December,	643,000	3,043,000	2,241,000	997,000	544,000	485,000
Average for whole year,	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000
Average for driest six months,	234,000	953,000	944,000	747,000	239,000	327,000

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile — Continued.

Month.	1893.	1894.	1895.	1896.	1897.	1898.
January,	433,000	693,000	1,034,000	1,084,000	845,000	1,638,000
February,	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000
March,	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000
April,	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000
May,	2,883,000	840,000	636,000	360,000	915,000	1,246,000
June,	440,000	419,000	174,000	399,000	962,000	530,000
July,	158,000	161,000	231,000	95,000	658,000	231,000
August,	181,000	209,000	229,000	57,000	591,000	1,107,000
September,	108,000	150,000	89,000	388,000	182,000	369,000
October,	221,000	374,000	1,379,000	592,000	94,000	1,160,000
November,	319,000	836,000	2,777,000	659,000	909,000	1,986,000
December,	797,000	716,000	1,782,000	657,000	1,584,000	1,799,000
Average for whole year,	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000
Average for driest six months,	237,000	356,000	460,000	314,000	564,000	777,000

Month.	1899.	1900.	1901.	1902.	1903.	1904.
January,	2,288,000	794,000	437,000	1,763,000	1,736,000	477,000
February,	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000
March,	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,999,000
April,	2,521,000	1,350,000	4,204,000	1,885,000	2,261,000	3,294,000
May,	511,000	1,312,000	2,954,000	743,000	351,000	1,745,000
June,	66,000	316,000	753,000	303,000	1,987,000	419,000
July,	19,000	—18,000	306,000	66,000	445,000	62,000
August,	—35,000	—34,000	424,000	135,000	307,000	170,000
September,	94,000	65,000	305,000	178,000	130,000	397,000
October,	115,000	186,000	412,000	506,000	492,000	191,000
November,	304,000	663,000	474,000	444,000	363,000	289,000
December,	220,000	1,096,000	2,695,000	1,779,000	582,000	269,000
Average for whole year,	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000
Average for driest six months,	93,000	194,000	445,000	271,000	388,000	228,000

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile — Continued.

Month.	1905.	1906.	1907.	1908.	1909.	1910.
January,	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000
February,	330,000	1,041,000	624,000	1,536,000	2,286,000	1,849,000
March,	2,497,000	2,409,000	1,658,000	2,257,000	1,734,000	1,954,000
April,	1,643,000	1,949,000	1,607,000	1,117,000	1,721,000	667,000
May,	297,000	1,059,000	888,000	1,046,000	1,004,000	277,000
June,	467,000	707,000	761,000	194,000	239,000	516,000
July,	177,000	398,000	9,000	—14,000	—121,000	—102,000
August,	114,000	180,000	—104,000	102,000	—45,000	—73,000
September,	1,246,000	19,000	541,000	—82,000	149,000	5,000
October,	158,000	301,000	741,000	47,000	—51,000	—51,000
November,	279,000	483,000	1,998,000	71,000	82,000	176,000
December,	887,000	659,000	2,032,000	136,000	263,000	221,000
Average for whole year,	795,000	860,000	1,010,000	694,000	625,000	570,000
Average for driest six months,	403,000	341,000	471,000	44,000	40,000	29,000

Month.	1911.	1912.	1913.	1914.	1915.	1916.
January,	519,000	728,000	1,041,000	908,000	1,629,000	942,000
February,	700,000	1,197,000	754,000	1,009,000	1,870,000	1,356,000
March,	1,144,000	3,092,000	2,090,000	3,029,000	593,000	1,820,000
April,	1,426,000	2,235,000	2,232,000	2,353,000	590,000	3,037,000
May,	318,000	1,447,000	867,000	1,550,000	255,000	1,439,000
June,	213,000	148,000	149,000	5,000	101,000	1,198,000
July,	—14,000	—77,000	—62,000	107,000	1,045,000	585,000
August,	20,000	—29,000	—54,000	156,000	1,168,000	78,000
September,	76,000	—28,000	88,000	—135,000	38,000	26,000
October,	296,000	—14,000	484,000	—59,000	231,000	—5,000
November,	593,000	165,000	480,000	97,000	261,000	110,000
December,	908,000	494,000	732,000	250,000	898,000	315,000
Average for whole year,	514,000	779,000	733,000	772,000	719,000	904,000
Average for driest six months,	152,000	26,000	180,000	29,000	480,000	186,000

Yield of the Sudbury River Drainage Area in Gallons per Day per Square Mile—Concluded.

Month.	1917.	Mean for Forty-three Years, 1875–1917.
January,	510,000	1,174,000
February,	755,000	1,655,000
March,	2,209,000	2,699,000
April,	1,405,000	1,987,000
May,	1,476,000	1,073,000
June,	1,044,000	498,000
July,	43,000	181,000
August,	202,000	243,000
September,	58,000	213,000
October,	482,000	413,000
November,	438,000	728,000
December,	380,000	945,000
Average for whole year,	750,000	980,000
Average for driest six months,	267,000	377,000

Note. — The recorded yields, subsequent to the year 1897, are less accurate than those for previous years, particularly during months of small yield, due to unavoidable inaccuracies in the measurement of large quantities of water received from the Wachusett Reservoir.

Nashua River.

The average flow of the South Branch of the Nashua River above Clinton during the year 1917 was 834,000 gallons per day per square mile of drainage area, or 79 per cent. of the normal flow for the past twenty-one years. The flow was in excess of the normal in the months of May, June and October, but less than the normal in the other nine months of the year. The greatest excess occurred in the month of June, and the greatest deficiency in the month of December. The average flow for the driest six months, July to December, inclusive, was 320,000 gallons per day per square mile, or about 61 per cent. of the normal flow for such a period during the past twenty-one years.

In order to show the relation between the flow of the Nashua River during each month of the year 1917 and the normal flow of that stream as deduced from observations during twenty-one years, from 1897 to 1917, inclusive, the following table has been prepared. The drainage area of the Nashua River above the point of measurement

was 119 square miles from 1897 to 1907, and 118.19 square miles from 1908 to 1913, inclusive. Since Jan. 1, 1914, the city of Worcester has been diverting water from 9.35 square miles of this drainage area for the supply of that city, leaving the net drainage area 108.84 square miles. In the calculations of yield allowance has been made for water overflowing from the Worcester area.

Table showing the Average Daily Flow of the South Branch of the Nashua River for Each Month in the Year 1917, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, the Departure from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1917.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January,	1.872	1.210	1.062	0.686	—0.810	—0.524
February,	2.145	1.387	1.418	0.916	—0.727	—0.471
March,	3.942	2.548	3.824	2.472	—0.118	—0.076
April,	3.309	2.139	2.272	1.468	—1.037	—0.671
May,	1.861	1.203	2.038	1.317	+0.177	+0.114
June,	1.222	0.790	1.902	1.229	+0.680	+0.439
July,	0.674	0.436	0.409	0.264	—0.265	—0.172
August,	0.663	0.428	0.479	0.309	—0.184	—0.119
September,	0.488	0.316	0.129	0.084	—0.359	—0.232
October,	0.756	0.489	0.858	0.555	+0.102	+0.066
November,	1.101	0.711	0.484	0.313	—0.617	—0.398
December,	1.711	1.106	0.602	0.389	—1.109	—0.717
Average for whole year,	1.643	1.062	1.290	0.834	—0.353	—0.228

In the annual report of the State Department of Health for the year 1915 (pages 324 to 327) tables were presented giving the record of the rainfall upon the drainage area of the Nashua River and the total yield expressed in inches in depth upon the drainage area (inches of rainfall collected) for each of the nineteen years, from 1897 to 1915, inclusive. The corresponding record for the years 1916 and 1917, together with the average for the entire period of twenty-one years, is given in the following table: —

Rainfall, in Inches, received and collected on the Nashua River Drainage Area.

Month.	1916.			1917.			Mean for Twenty-one Years, 1897-1917.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January,	1.60	2.346	146.7	3.37	1.224	36.3	3.65	2.159	59.1
February,	5.98	3.030	50.7	3.05	1.476	48.3	3.78	2.250	59.5
March,	3.32	3.374	101.5	4.21	4.409	104.8	4.12	4.546	110.4
April,	3.65	5.696	156.0	1.80	2.535	140.6	3.72	3.692	99.3
May,	3.34	3.028	90.7	3.89	2.350	60.5	3.38	2.146	63.4
June,	6.57	3.546	53.9	4.47	2.122	47.4	3.72	1.363	36.6
July,	5.66	1.937	34.2	1.22	0.471	38.8	4.00	0.777	19.0
August,	1.72	0.506	29.5	4.46	0.552	12.4	4.20	0.764	18.2
September,	4.21	0.506	12.0	1.20	0.144	12.0	3.42	0.545	15.9
October,	1.42	0.250	17.6	6.03	0.990	16.4	3.47	0.872	25.1
November,	3.15	0.554	17.6	1.25	0.540	43.1	3.28	1.228	37.5
December,	2.81	0.820	29.2	2.31	0.694	30.0	4.08	1.973	48.4
Totals and averages,	43.43	25.593	58.9	37.26	17.507	47.0	44.91	22.315	49.7

The following table gives a record of the yield of the drainage area of the Nashua River for each of the past twenty-one years, the flow being expressed in gallons per day per square mile of drainage area: —

Yield of the Nashua River Drainage Area in Gallons per Day per Square Mile.[1]

Month.	1897.	1898.	1899.	1900.	1901.	1902.
January,	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000
February,	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000
March,	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000
April,	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000
May,	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000
June,	1,181,000	828,000	561,000	578,000	985,000	410,000
July,	1,442,000	333,000	354,000	217,000	477,000	292,000
August,	896,000	1,325,000	236,000	197,000	512,000	297,000
September,	380,000	676,000	250,000	127,000	320,000	241,000
October,	243,000	1,509,000	245,000	282,000	647,000	950,000
November,	1,283,000	2,170,000	430,000	875,000	517,000	635,000
December,	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000
Average for whole year,	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000
Average for driest six months,	886,000	1,013,000	312,000	377,000	576,000	471,000

[1] The drainage area used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902, inclusive, to 2.4 per cent. in 1903, to 3.6 per cent. in 1904, to 4.1 per cent. in 1905, to 5.1 per cent. in 1906, to 6 per cent. in 1907, to 7 per cent. in 1908, 1909 and 1910, to 6.5 per cent. in 1911, to 6.8 per cent. in 1912, to 7 per cent. in 1913, to 7.4 per cent. in 1914 and 1915, to 7.6 per cent. in 1916 and to 7.4 per cent. in 1917.

Yield of the Nashua River Drainage Area in Gallons per Day per Square Mile — Continued.

Month.	1903.	1904.	1905.	1906.	1907.	1908.
January,	1,265,000	659,000	1,266,000	1,132,000	1,458,000	1,738,000
February,	2,133,000	927,000	452,000	1,027,000	692,000	1,736,000
March,	3,423,000	3,008,000	3,004,000	1,860,000	1,697,000	2,192,000
April,	2,238,000	2,984,000	1,617,000	2,109,000	1,436,000	1,269,000
May,	569,000	1,498,000	445,000	1,533,000	965,000	1,415,000
June,	2,131,000	762,000	542,000	1,184,000	773,000	403,000
July,	624,000	497,000	365,000	728,000	335,000	220,000
August,	474,000	355,000	321,000	591,000	87,000	443,000
September,	375,000	494,000	1,228,000	277,000	810,000	88,000
October,	689,000	347,000	367,000	530,000	1,382,000	158,000
November,	634,000	343,000	442,000	749,000	2,540,000	125,000
December,	954,000	440,000	1,018,000	794,000	1,961,000	387,000
Average for whole year,	1,285,000	1,025,000	926,000	1,043,000	1,180,000	847,000
Average for driest six months,	626,000	413,000	541,000	613,000	725,000	238,000

Month.	1909.	1910.	1911.	1912.	1913.	1914.
January,	592,000	1,846,000	773,000	780,000	1,414,000	990,000
February,	2,556,000	1,845,000	625,000	927,000	867,000	1,181,000
March,	2,129,000	2,640,000	1,339,000	2,831,000	2,263,000	3,137,000
April,	2,422,000	1,034,000	1,393,000	2,281,000	2,083,000	2,593,000
May,	1,212,000	608,000	461,000	1,797,000	1,038,000	1,699,000
June,	632,000	824,000	351,000	331,000	280,000	317,000
July,	233,000	62,000	57,000	135,000	19,000	329,000
August,	193,000	186,000	188,000	125,000	60,000	261,000
September,	208,000	145,000	181,000	89,000	219,000	—12,000
October,	90,000	68,000	718,000	145,000	678,000	136,000
November,	363,000	354,000	1,035,000	442,000	660,000	211,000
December,	537,000	391,000	1,067,000	793,000	955,000	372,000
Average for whole year,	918,000	828,000	682,000	891,000	879,000	934,000
Average for driest six months,	270,000	201,000	327,000	210,000	318,000	208,000

Yield of the Nashua River Drainage Area in Gallons per Day per Square Mile — Concluded.

Month.	1915.	1916.	1917.	Mean for Twenty-one Years, 1897-1917.
January,	2,062,000	1,315,000	686,000	1,210,000
February,	1,961,000	1,816,000	916,000	1,387,000
March,	572,000	1,891,000	2,472,000	2,548,000
April,	926,000	3,300,000	1,468,000	2,139,000
May,	455,000	1,697,000	1,317,000	1,203,000
June,	228,000	2,054,000	1,229,000	790,000
July,	1,083,000	1,086,000	264,000	436,000
August,	1,657,000	284,000	309,000	428,000
September,	158,000	294,000	84,000	316,000
October,	387,000	140,000	555,000	489,000
November,	498,000	321,000	313,000	711,000
December,	1,359,000	460,000	389,000	1,106,000
Average for whole year,	942,000	1,215,000	834,000	1,062,000
Average for driest six months,	666,000	432,000	320,000	527,000

Merrimack River.

The flow of the Merrimack River has been measured for many years at Lawrence, above which place the river has a total drainage area of 4,663 square miles, which includes 118[1] square miles on the South Branch of the Nashua River, 75 square miles on the Sudbury River, and 18 square miles tributary to Lake Cochituate, or a combined area of 211[1] square miles from which water is drawn at the present time for the supply of the Metropolitan Water District. The flow as measured at Lawrence includes the water wasted from these three drainage areas, which, in the wet months of the year, is very considerable but which becomes very small in the dry months. Records of the quantity of water wasted have been kept by the Boston Water Board and by the Metropolitan Water and Sewerage Board, and these quantities have been deducted from the flow as measured at Lawrence. These three drainage areas have also been deducted from the total drainage area above Lawrence, so that the net drainage area above that point was 4,567 square miles in 1880, 4,570 square miles in the years 1881 to 1897, inclusive, and 4,452 square miles since the latter year.

[1] Including 9.35 square miles from which water is drawn for the supply of the city of Worcester.

The average flow of the Merrimack River during the year 1917 amounted to 1.398 cubic feet per second, or 903,000 gallons per day, per square mile of drainage area, or 94 per cent. of the normal flow for the past thirty-eight years for which records are available. The flow was in excess of the normal in the months of June and July, and less than the normal in the other ten months of the year.

In order to show the relation between the flow of this stream during each month of the year 1917 and the normal flow as deduced from observations during thirty-eight years, from 1880 to 1917, inclusive, the following table has been prepared: —

Table showing the Average Monthly Flow of the Merrimack River at Lawrence for the Year 1917, in Cubic Feet per Second per Square Mile of Drainage Area; also, the Departure from the Normal Flow.

Month.	Normal Flow, 1880-1917.	Actual Flow in 1917.	Excess or Deficiency.
January,	1.305	1.023	—0.282
February,	1.431	0.770	—0.661
March,	2.715	2.316	—0.399
April,	3.680	3.242	—0.438
May,	2.188	2.124	—0.064
June,	1.277	3.037	+1.760
July,	0.752	1.024	+0.272
August,	0.690	0.629	—0.061
September,	0.646	0.549	—0.097
October,	0.806	0.613	—0.193
November,	1.109	0.882	—0.227
December,	1.209	0.569	—0.640
Average for whole year,	1.484	1.398	—0.086

The following table gives the record of the net flow of the Merrimack River at Lawrence for each of the past thirty-eight years, the flow being expressed in cubic feet per second per square mile of net drainage area: —

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile.

Month.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
January,	1.618	0.504	1.604	0.442	1.019	1.137	2.859	1.644	1.388	2.619
February,	2.687	1.027	2.016	0.634	2.054	0.938	3.798	2.823	1.818	1.345
March,	2.292	3.641	3.483	0.861	3.339	0.738	2.581	1.769	2.168	2.385
April,	2.358	3.511	2.268	3.382	5.656	3.967	4.931	4.788	5.377	2.408
May,	1.209	3.101	2.320	1.854	2.585	1.838	1.478	3.001	4.539	1.437
June,	0.696	1.094	1.963	1.100	0.893	0.917	0.714	1.786	1.228	1.164
July,	0.646	0.751	0.687	0.684	0.500	0.623	0.497	1.458	0.548	0.782
August,	0.554	0.611	0.470	0.423	0.461	1.191	0.435	1.866	0.577	1.087
September,	0.490	0.549	0.812	0.266	0.426	0.632	0.434	0.918	1.540	0.750
October,	0.388	0.545	0.678	0.432	0.400	0.749	0.471	0.682	2.656	1.220
November,	0.929	1.157	0.505	0.627	0.522	1.988	1.538	0.966	2.888	1.924
December,	0.580	1.832	0.472	0.515	1.022	1.496	1.296	1.337	3.181	2.812
Average for whole year,	1.204	1.527	1.440	0.935	1.573	1.351	1.753	1.920	2.326	1.661
Average for driest six months.	0.598	0.785	0.604	0.491	0.534	0.992	0.671	1.205	1.573	1.073

Month.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
January,	1.492	2.823	1.836	0.645	0.661	0.626	1.419	0.745	1.613	1.657
February,	1.656	2.851	0.925	1.081	0.933	0.507	1.941	1.000	1.638	1.032
March,	3.326	5.041	1.562	2.281	3.115	1.258	4.510	2.294	4.042	2.479
April,	3.728	4.645	1.774	3.359	2.401	4.289	3.967	3.839	3.316	5.757
May,	3.096	1.601	2.215	4.202	1.525	1.360	0.971	2.209	2.399	2.121
June,	1.716	0.990	1.272	0.963	1.317	0.664	0.769	2.769	1.416	0.667
July,	0.691	0.633	1.040	0.522	0.498	0.565	0.446	2.359	0.585	0.556
August,	0.745	0.538	1.051	0.564	0.370	0.477	0.441	1.105	0.776	0.467
September,	1.833	0.556	0.863	0.608	0.400	0.366	0.683	0.603	0.636	0.447
October,	2.648	0.467	0.467	0.790	0.493	0.863	1.134	0.482	1.372	0.401
November,	1.918	0.540	1.420	0.736	0.772	2.047	1.454	1.274	2.094	0.625
December,	1.418	0.899	0.859	1.166	0.661	2.025	0.952	2.262	1.871	0.622
Average for whole year,	2.022	1.799	1.274	1.410	1.095	1.254	1.557	1.745	1.813	1.403
Average for driest six months.	1.542	0.605	0.950	0.697	0.532	0.716	0.741	1.348	1.146	0.519

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile — Concluded.

MONTH.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.
January,	0.748	0.752	2.268	1.684	0.584	0.855	1.705	1.411	1.946	0.677
February,	3.520	0.546	1.196	1.979	0.644	0.503	1.133	0.667	1.648	1.563
March,	3.441	2.063	6.011	6.031	2.719	2.349	1.677	1.728	2.499	1.695
April,	4.087	5.568	3.801	3.375	4.494	3.615	3.591	2.923	2.652	3.404
May,	2.185	3.342	2.255	0.979	3.843	1.169	2.269	2.034	2.570	1.951
June,	0.878	1.656	1.187	2.224	1.016	0.931	2.262	1.190	0.932	0.948
July,	0.407	0.644	0.970	1.032	0.624	0.600	1.106	0.749	0.522	0.447
August,	0.420	0.989	0.844	0.734	0.573	0.606	0.741	0.431	0.668	0.376
September,	0.338	0.588	0.774	0.530	0.653	1.706	0.422	0.664	0.379	0.369
October,	0.564	0.913	1.600	0.826	0.816	0.727	0.549	1.433	0.330	0.422
November,	1.304	0.654	1.285	0.665	0.604	0.760	0.707	2.914	0.354	0.388
December,	1.486	2.054	1.755	0.825	0.407	1.274	0.566	2.177	0.420	0.504
Average for whole year,	1.615	1.647	1.995	1.740	1.415	1.258	1.394	1.527	1.243	1.062
Average for driest six months.	0.652	0.907	1.110	0.769	0.613	0.888	0.682	1.083	0.445	0.418

MONTH.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.	Mean for Thirty-eight Years, 1880-1917.
January,	1.043	0.624	0.802	1.775	0.734	1.080	1.527	1.023	1.305
February,	0.973	0.482	0.706	0.987	0.958	1.742	1.674	0.770	1.431
March,	3.611	1.248	2.773	3.372	3.245	1.485	1.735	2.316	2.715
April,	2.445	3.045	4.323	2.490	4.954	1.788	4.323	3.242	3.680
May,	1.509	1.360	2.297	1.442	2.880	1.126	2.733	2.124	2.188
June,	1.077	0.551	1.304	0.899	0.737	0.489	3.101	3.037	1.277
July,	0.398	0.266	0.412	0.393	0.559	1.810	1.531	1.024	0.752
August,	0.458	0.328	0.499	0.306	0.434	2.064	0.924	0.629	0.690
September,	0.397	0.435	0.485	0.387	0.445	0.655	0.972	0.549	0.646
October,	0.300	0.918	0.733	0.791	0.303	0.657	0.798	0.613	0.806
November,	0.457	1.049	1.239	0.967	0.356	0.874	0.743	0.882	1.109
December,	0.335	1.284	1.069	1.046	0.437	1.303	1.154	0.569	1.209
Average for whole year,	1.084	0.966	1.387	1.238	1.337	1.256	1.768	1.398	1.484
Average for driest six months,	0.391	0.591	0.739	0.624	0.422	1.092	1.020	0.711	0.869

Sudbury, Nashua and Merrimack Rivers.

The following table shows the weekly fluctuation during the year 1917 in the flow of the three streams just described, — namely, the Sudbury River at Framingham, the South Branch of the Nashua River above Clinton, and the Merrimack River at Lawrence. The flow of these streams, particularly that of the Sudbury and of the South Branch of the Nashua River, serves to indicate the flow of other streams in eastern Massachusetts. The area of the Sudbury River watershed is 75.2 square miles, and of the South Branch of the Nashua River, 118.19 square miles. The net watershed area of the Merrimack River is 4,452 square miles.

Table showing the Average Weekly Flow of the Sudbury, South Branch of the Nashua and the Merrimack Rivers for the Year 1917 in Cubic Feet per Second per Square Mile of Drainage Area.

Week ending Sunday —	Flow in Cubic Feet per Second per Square Mile.			Week ending Sunday —	Flow in Cubic Feet per Second per Square Mile.		
	Sudbury River.	South Branch Nashua River.	Merrimack River.		Sudbury River.	South Branch Nashua River.	Merrimack River.
Jan. 7,	0.744	1.244	0.836	July 1,	0.619	1.044	2.178
14,	0.857	1.381	1.239	8,	0.154	0.425	1.471
21	1.084	1.165	1.195	15,	0.373	0.802	0.960
28,	0.495	0.589	0.856	22,	0.056	0.302	0.832
				29,	—0.136	0.131	0.742
Feb. 4,	0.638	0.718	0.787	Aug. 5,	—0.242	0.058	0.617
11,	0.561	0.777	0.761	12,	0.209	0.285	0.582
18,	0.237	0.535	0.725	19,	0.182	0.286	0.544
25,	0.594	0.764	0.713	26,	0.420	1.018	0.712
Mar. 4,	4.007	4.664	1.415	Sept. 2,	0.786	0.690	0.770
11,	1.969	2.091	1.228	9,	0.092	0.070	0.718
18,	3.895	2.904	1.516	16,	—0.166	—0.036	0.553
25,	3.433	4.149	1.980	23,	0.210	0.172	0.467
				30,	—0.008	0.197	0.429
Apr. 1,	5.111	6.826	5.262	Oct. 7,	0.031	0.168	0.415
8,	3.147	3.531	4.119	14,	0.209	0.303	0.506
15,	2.322	2.016	3.019	21,	0.349	0.427	0.548
22,	1.690	1.837	2.528	28,	1.763	1.728	0.710
29,	1.496	1.662	3.241				
May 6,	2.745	2.865	2.499	Nov. 4,	1.671	1.539	1.700
13,	2.949	2.218	2.500	11,	0.606	0.302	0.825
20,	1.448	1.102	1.831	18,	0.374	0.306	0.682
27,	1.386	1.561	1.891	25,	0.760	0.739	0.639
June 3,	2.059	2.099	1.774	Dec. 2,	0.957	0.754	0.594
10,	1.638	1.416	2.007	9,	0.993	0.672	0.692
17,	2.815	3.205	3.969	16,	0.619	0.660	0.553
24,	1.779	1.950	4.389	23,	0.275	0.436	0.542
				30,	0.249	0.415	0.523

Examination of Rivers.

The condition of the various rivers of the State has been examined as usual during the year by the chief engineer or his assistants, and samples of the water have been collected for chemical analysis at stations established by this Department many years ago on nearly all of the important streams. In a few cases the samples are collected monthly throughout the year, but for the most part they are collected during the six dry months of the year, from June to November, inclusive, since in that part of the year the dilution of sewage in polluted streams is least, and the effect of pollution is most noticeable.

The flow of streams in 1917, judging from the flow of the Nashua River, was less than the normal in all of the months excepting May, June and October, and the only notable excess in these three months was in the month of June. As a result of the high rainfall in the late spring and in the months of August and October, the quantity of water available for the dilution of polluting matters was greater in some of the months in the drier portion of the year than in the corresponding months of some of the previous dry years, and consequently the effect of pollution in a few instances was not as noticeable as in some of those years; but in most of the streams, in spite of the higher flow, the conditions were more objectionable than in previous years, this being due in large measure to the great increase in the amount of polluting wastes discharged from industrial establishments.

A statement of the condition of each of the more important streams affected by sewage or manufacturing pollution will be found in a subsequent part of this report. The results show in general continued deterioration in the condition of many of the more polluted streams, such as the Blackstone, Neponset, Nashua and Hoosick rivers, which at certain points is highly objectionable.

The results of chemical examinations of the following rivers are presented herewith: —

Assabet.
Blackstone.
Charles.
Chicopee.
Concord.
Connecticut.
Deerfield.
French.
Green.
Hoosick.

Housatonic.	Quinebaug.
Merrimack.	Sudbury.
Miller's.	Taunton.
Nashua.	Ten Mile.
Neponset.	Ware.
Quaboag.	Westfield.

Blackstone River.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River. — Averages for Six Months, from June to November, inclusive.

Blackstone River, below Cherry Valley.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1908,	–	20.57	3.83	.1531	.0624	.0508	.0116	5.76	.0020	.0007	–	–
1909,	.35	13.93	3.34	.0681	.0470	.0334	.0136	3.70	.0125	.0003	.80	–
1910,	.32	16.42	3.92	.0633	.0489	.0387	.0102	4.02	.0146	.0002	.85	–
1911,	–	21.02	4.40	.1277	.0726	.0559	.0167	5.70	.0080	.0005	1.15	–
1912,[1]	–	44.10	11.04	.2514	.2884	.1023	.1861	10.70	.0002	.0004	3.08	–
1913,	–	32.32	6.52	.2591	.1628	.1122	.0506	8.18	.0015	.0004	2.06	–
1914,	–	44.73	7.27	.3430	.1857	.1379	.0478	12.83	.0000	.0001	2.12	–
1915,	–	19.23	5.15	.0985	.1142	.0785	.0357	3.08	–	–	1.89	–
1916,	–	14.18	5.27	.0209	.0809	.0544	.0265	1.25	–	–	1.50	–
1917,	–	20.67	7.48	.0406	.1279	.0762	.0517	2.36	–	–	2.20	–

[1] August omitted.

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. — *Continued.*

Blackstone River, between Mill Brook Channel and the Sewage Precipitation Works of the City of Worcester.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1887,	0.91	–	–	.2686	.1741	–	–	1.35	.0160	–	–
1888,	0.76	–	–	.2658	.1112	.0557	.0555	1.50	.0382	.0041	–
1889,	0.86	–	–	.3980	.1430	.0772	.0658	1.32	.0177	.0026	–
1890,	1.14	9.92	3.03	.2107	.1246	.0673	.0573	1.07	.0250	.0015	2.9
1891,	1.10	17.42	5.59	.4913	.1950	.1127	.0823	2.29	.0192	.0037	5.0
1892,	0.52	20.75	6.30	.3547	.1433	.0708	.0725	2.43	.0227	.0108	6.1
1893,	0.40	16.98	4.55	.1480	.0588	.0240	.0348	1.01	.0115	.0015	6.3
1894,	0.66	16.93	4.76	.0548	.0380	.0236	.0144	0.74	.0115	.0005	4.4
1895,	0.49	14.17	4.50	.0613	.0414	.0243	.0171	0.92	.0163	.0006	3.4
1896,	0.51	12.90	2.93	.0780	.0415	.0282	.0133	0.97	.0147	.0015	3.4
1897,	0.85	26.45	7.68	.1130	.0674	.0362	.0312	0.89	.0090	.0024	4.2
1898,	0.33	17.42	5.62	.0857	.0619	.0260	.0359	0.96	.0053	.0010	4.6
1899,	0.14	34.38	10.60	.2583	.0788	.0390	.0398	–	–	.0004	14.3
1900,	0.05	16.48	3.38	.1068	.0518	.0210	.0308	1.03	.0107	.0012	3.6
1901,	0.23	31.03	11.68	.1410	.0548	.0309	.0239	–	–	.0023	13.8
1902,	0.10	46.15	12.47	.2453	.0728	.0274	.0454	–	–	.0010	16.5
1903,	0.18	24.06	6.80	.2836	.0750	.0472	.0278	–	–	.0027	8.4
1904,	0.12	44.68	17.08	.1228	.0434	.0225	.0209	–	–	.0008	14.7
1905,	0.21	50.36	19.49	.0952	.0492	.0203	.0289	–	–	.0003	29.3
1906,	0.11	40.07	15.25	.0688	.0421	.0189	.0232	–	.0032	.0002	20.3
1907,	0.04	44.07	17.67	.0613	.0343	.0180	.0163	–	–	.0003	–
1908,	0.16	23.67	5.55	.0990	.0291	.0153	.0138	3.23	.0134	.0014	–
1909,	–	52.97	18.55	.1865	.0381	.0239	.0142	4.80	.0033	.0010	–
1910,	0.15	50.92	18.97	.1933	.0545	.0309	.0236	4.07	.0023	.0009	–
1911,	0.11	44.64	15.70	.1920	.0449	.0212	.0237	4.03	.0170	.0009	–
1912,	0.10	40.05	10.91	.2047	.0352	.0225	.0127	3.58	.0027	.0011	–
1913,	0.10	35.17	10.34	.2767	.0491	.0285	.0206	3.18	.0003	.0008	–
1914,	0.14	35.03	8.23	.2993	.0771	.0510	.0261	3.85	.0012	.0018	–
1915,	0.13	39.00	11.68	.2383	.0650	.0392	.0258	2.96	–	–	–
1916,[1]	–	29.10	8.20	.2483	.0549	.0354	.0195	2.08	–	–	–
1917,[2]	0.23	42.38	11.04	.4864	.0612	.0379	.0233	2.19	–	–	–

[1] September omitted. [2] November omitted.

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. — *Continued.*

Blackstone River, below Sewage Precipitation Works.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1890,	0.97	11.36	3.10	.2907	.1492	.0722	.0770	1.46	.0270	.0018	3.9
1891,	1.05	22.25	6.60	.6367	.1508	.0883	.0625	2.61	.0233	.0040	6.2
1892,	0.63	26.80	7.75	.5240	.1810	.0958	.0852	3.13	.0137	.0050	10.3
1893,	0.51	30.00	7.13	.5680	.1453	.0900	.0553	2.76	.0285	.0126	10.9
1894,	0.40	29.30	5.86	.6189	.1390	.1113	.0277	2.63	.0212	.0071	10.6
1895,	0.71	22.15	5.18	.3246	.0898	.0597	.0301	1.86	.0267	.0063	7.3
1896,	0.30	26.03	6.53	.2831	.0898	.0600	.0298	2.10	.0217	.0118	9.7
1897,	0.73	25.98	4.97	.3650	.1122	.0782	.0340	1.61	.0207	.0063	6.9
1898,	0.23	25.63	6.73	.3064	.0868	.0560	.0308	1.55	.0132	.0119	9.2
1899,	0.14	44.02	9.67	.5251	.1707	.0912	.0795	3.26	.0108	.0068	16.1
1900,	0.22	24.57	4.48	.4430	.1249	.0621	.0628	2.13	.0110	.0145	7.3
1901,	0.09	31.12	6.90	.4580	.1293	.0772	.0521	3.42	.0090	.0058	10.8
1902,	0.15	49.62	13.38	.7296	.1284	.0736	.0548	2.97	–	.0033	12.5
1903,	0.39	31.08	9.48	.3880	.1080	.0545	.0535	–	–	.0062	10.4
1904,	–	50.25	13.73	.6381	.1523	.0601	.0922	–	–	.0027	16.9
1905,	0.19	59.84	17.97	.4936	.0985	.0597	.0388	–	–	.0008	29.3
1906,	0.19	49.69	11.42	.6330	.1818	.0580	.1238	–	.0055	.0130	15.0
1908,	0.30	38.80	7.63	.9407	.1490	.0781	.0709	5.34	.0040	.0033	–
1909,	–	53.79	12.12	1.0567	.1282	.0792	.0490	6.92	.0067	.0075	–
1910,	–	52.15	12.52	1.0090	.1654	.0817	.0837	5.68	.0015	.0034	–
1911,	0.21	53.25	13.15	.9967	.1608	.0651	.0957	6.54	.0152	.0072	–
1912,	0.23	48.90	10.08	1.1700	.1673	.0904	.0769	6.12	.0137	.0096	–
1913,[1]	0.28	40.68	10.46	.9320	.1286	.0719	.0567	4.49	.0158	.0084	–
1914,	0.25	43.46	9.08	.8577	.1114	.0770	.0344	4.87	.0038	.0091	–
1915,	0.13	39.45	6.77	.6370	.1032	.0575	.0457	3.58	–	–	–
1916,[1]	–	49.21	9.00	.6684	.1031	.0607	.0424	3.69	–	–	–
1917,[2]	–	50.37	12.46	.9350	.0926	.0610	.0316	4.25	–	–	–

[1] September omitted.

[2] July omitted.

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. — *Continued.*

Blackstone River, at Uxbridge.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1887,	.39	–	–	.1129	.0271	–	–	0.79	.0360	–	–
1888,	.38	6.42	1.52	.1155	.0288	.0222	.0066	0.68	.0310	.0007	–
1889,	.32	–	–	.1133	.0296	.0192	.0104	0.66	.0333	.0009	–
1890,	.26	8.86	2.12	.1629	.0231	.0174	.0057	0.79	.0259	.0005	2.9
1891,	.20	10.16	2.61	.2280	.0175	.0117	.0058	1.04	.0425	.0007	3.6
1892,	.13	9.36	1.88	.2840	.0227	.0162	.0065	0.99	.0313	.0007	3.1
1893,	.24	11.74	2.37	.1985	.0207	.0140	.0067	1.20	.0623	.0050	4.2
1894,	.35	13.07	2.03	.1456	.0243	.0183	.0060	1.57	.0673	.0050	4.9
1895,	.56	12.95	2.69	.0906	.0258	.0182	.0076	1.34	.0631	.0065	4.7
1896,	.33	12.68	2.67	.1129	.0257	.0221	.0036	1.38	.0477	.0091	5.0
1897,	.48	11.60	2.47	.1029	.0280	.0215	.0065	1.32	.0652	.0051	4.3
1898,	.49	10.59	2.78	.0801	.0264	.0219	.0045	1.00	.0470	.0076	3.8
1899,	.18	18.34	3.11	.2490	.0359	.0310	.0049	2.17	.0510	.0141	7.4
1900,	.19	13.42	2.04	.2260	.0347	.0257	.0090	1.76	.0558	.0060	5.0
1901,	.22	13.91	2.67	.3159	.0285	.0240	.0045	1.50	.0195	.0035	5.0
1902,	.15	14.17	2.56	.3462	.0270	.0218	.0052	1.95	.0210	.0018	4.9
1903,	.30	13.16	2.52	.3030	.0262	.0215	.0047	1.74	.0210	.0024	4.4
1904,	.20	13.78	2.74	.2399	.0282	.0214	.0068	2.12	.0408	.0022	4.6
1905,	.21	16.34	2.55	.3928	.0246	.0203	.0043	2.65	.0175	.0025	5.0
1906,	.19	14.73	3.10	.2218	.0242	.0200	.0042	2.10	.0252	.0009	4.2
1907,	.37	14.23	2.58	.2331	.0238	.0182	.0056	2.36	.0330	.0040	4.5
1908,	.31	16.33	4.07	.2387	.0253	.0196	.0057	3.05	.0408	.0071	–
1909,	.22	18.31	4.35	.3473	.0273	.0216	.0057	3.64	.0325	.0066	–
1910,	.26	22.53	4.69	.4963	.0356	.0302	.0054	4.62	.0498	.0043	–
1911,	.26	23.10	3.85	.3717	.0293	.0225	.0068	4.15	.0558	.0173	–
1912,	.21	21.91	3.06	.4897	.0345	.0288	.0057	4.06	.0497	.0137	6.5
1913,	.29	19.48	3.70	.3880	.0355	.0281	.0074	3.34	.0382	.0107	5.5
1914,	.25	23.72	2.84	.5285	.0355	.0284	.0071	4.55	.0482	.0154	7.2
1915,	.30	19.63	2.75	.3068	.0381	.0302	.0079	3.10	–	–	6.3
1916,[1]	.32	20.42	4.72	.3766	.0376	.0293	.0083	2.74	–	–	6.3
1917,	.22	22.21	4.28	.3904	.0365	.0286	.0079	3.27	–	–	–

[1] August omitted.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River, etc. — *Concluded.*

Blackstone River, at Millville.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1887,	.31	-	-	.0468	.0220	-	-	0.51	.0210	-	-
1888,	.41	5.22	1.40	.0467	.0296	.0233	.0063	0.50	.0278	.0004	-
1889,	.38	-	-	.0499	.0273	.0213	.0060	0.45	.0167	.0003	-
1890,	.26	6.71	2.24	.0736	.0196	.0152	.0044	0.53	.0229	.0003	2.3
1891,	.24	7.48	2.35	.1105	.0384	.0234	.0150	0.72	.0308	.0006	2.2
1892,	.37	6.70	1.62	.1143	.0294	.0210	.0084	0.63	.0217	.0002	2.0
1893,	.23	7.43	1.73	.0677	.0119	.0087	.0032	0.77	.0385	.0011	2.6
1894,	.47	8.42	2.16	.0510	.0172	.0139	.0033	0.89	.0273	.0012	2.8
1895,	.51	8.67	2.55	.0356	.0233	.0180	.0053	0.90	.0383	.0024	3.2
1896,	.35	8.53	1.69	.0484	.0237	.0180	.0057	0.97	.0413	.0027	3.3
1897,	.45	7.66	1.98	.0509	.0258	.0210	.0048	0.92	.0145	.0019	3.1
1898,	.51	7.12	2.17	.0325	.0240	.0193	.0047	0.63	.0240	.0023	2.5
1899,	.20	12.50	2.44	.1310	.0301	.0247	.0054	1.31	.0310	.0049	4.6
1900,	.29	9.33	1.82	.1168	.0254	.0219	.0035	1.15	.0417	.0039	3.4
1901,	.31	8.62	2.13	.1420	.0288	.0227	.0061	0.87	.0155	.0006	3.1
1902,	.28	9.43	2.24	.1623	.0284	.0238	.0046	1.20	.0195	.0010	2.8
1903,	.33	8.46	1.85	.1397	.0233	.0189	.0044	1.10	.0192	.0010	2.9
1904,	.29	8.71	2.06	.1079	.0235	.0201	.0034	1.26	.0337	.0009	2.9
1905,	.28	10.76	2.03	.1956	.0311	.0222	.0089	1.67	.0207	.0008	2.9
1906,	.37	9.02	2.15	.1526	.0306	.0251	.0055	1.27	.0188	.0006	2.4
1907,	.37	10.43	2.21	.1521	.0240	.0181	.0059	1.61	.0247	.0014	3.1
1908,	.33	9.85	2.53	.1295	.0232	.0185	.0047	1.78	.0258	.0024	3.4
1909,	.24	11.87	3.17	.1595	.0267	.0220	.0047	2.27	.0225	.0019	-
1910,	.30	13.94	3.32	.2350	.0277	.0234	.0043	3.01	.0290	.0013	-
1911,	.33	14.35	2.79	.1787	.0268	.0222	.0046	2.94	.0355	.0051	-
1912,	.29	15.20	2.18	.2433	.0283	.0249	.0034	2.91	.0421	.0064	-
1913,	.37	12.92	2.38	.1631	.0281	.0237	.0044	2.44	.0345	.0063	-
1914,	.28	14.33	2.78	.2245	.0304	.0243	.0061	2.78	.0233	.0065	-
1915,	.42	13.55	2.02	.1379	.0361	.0267	.0094	2.12	-	-	-
1916,	.38	13.31	2.78	.2284	.0266	.0199	.0067	1.86	-	-	-
1917,	.33	14.19	3.96	.1572	.0286	.0222	.0064	2.12	-	-	-

Charles River.

A general statement of the condition of this river in the year 1917 will be found on page 244.

Chemical Examination of Water from Charles River. — Averages for Six Months, from June to November, inclusive.

Charles River, above Milford.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1899,	.28	3.98	1.70	.0017	.0248	.0223	.0025	.27	.0027	.0003	.48	0.6
1900,	.49	3.93	1.67	.0017	.0251	.0231	.0020	.25	.0030	.0000	.64	0.5
1901,	.46	4.30	2.48	.0066	.0286	.0247	.0039	.25	.0060	.0002	.65	0.6
1902,	.58	4.42	1.90	.0025	.0248	.0210	.0038	.29	.0057	.0001	.70	1.1
1903,[1]	.56	4.17	1.86	.0015	.0203	.0171	.0032	.28	.0080	.0001	.68	0.8
1904,[2]	.49	3.95	1.83	.0117	.0267	.0209	.0058	.33	.0035	.0001	.62	1.1
1905,[3]	.55	3.77	1.62	.0020	.0229	.0201	.0028	.31	.0033	.0001	.56	0.8
1906,[3]	.62	4.05	1.90	.0032	.0257	.0230	.0027	.30	.0073	.0001	.68	0.6
1907,	.43	3.79	1.59	.0020	.0198	.0173	.0025	.32	.0047	.0001	.48	0.8
1908,	.36	3.11	1.43	.0023	.0198	.0171	.0027	.33	.0025	.0001	.42	0.5
1909,	.31	3.52	1.62	.0030	.0207	.0176	.0031	.32	.0012	.0000	.39	0.7
1910,	.37	3.47	1.34	.0042	.0231	.0204	.0027	.37	.0011	.0001	.46	0.8
1911,	.40	3.94	1.48	.0036	.0210	.0183	.0027	.42	.0007	.0000	.56	1.1
1912,	.38	3.62	1.29	.0037	.0226	.0182	.0044	.37	.0018	.0001	.45	1.0
1913,[3]	.47	4.40	1.50	.0060	.0245	.0222	.0023	.39	.0023	.0002	.49	0.9
1914,[3]	.34	4.03	1.43	.0046	.0228	.0178	.0050	.41	.0000	.0000	.35	0.9
1915,[3]	.75	5.00	2.27	.0039	.0296	.0260	.0036	.41	–	–	.84	1.1
1916,[3]	.49	4.70	2.23	.0058	.0219	.0207	.0012	.37	–	–	.75	1.0
1917,	.43	4.96	1.58	.0062	.0197	.0157	.0040	.35	–	–	.53	1.3

[1] October omitted. [2] Two months. [3] Three months.

Charles River, below Milford.

Year.	Color.	Residue Total.	Loss on Ignition.	Free.	Alb. Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1898,	.63	10.47	3.08	.1195	.0597	.0422	.0175	2.47	.0473	.0064	.69	2.4
1899,	.50	12.52	3.12	.3487	.1345	.0803	.0542	3.00	.0053	.0008	1.12	2.6
1900,	.56	12.85	2.65	.7123	.0764	.0563	.0201	2.74	.0140	.0055	.93	3.1
1901,	.63	9.52	3.37	.1419	.0451	.0317	.0134	1.40	.0422	.0048	.86	2.6
1902,	.52	10.74	3.38	.2118	.0658	.0406	.0252	2.21	.0236	.0049	1.02	2.7
1903,[1]	.49	9.03	2.85	.2237	.0479	.0277	.0202	1.36	.0396	.0050	.66	2.5
1904,[2]	.50	9.20	2.94	.2105	.0508	.0350	.0158	1.44	.0513	.0055	.63	2.6
1906,[3]	.68	8.76	2.90	.1536	.0568	.0427	.0141	1.64	.0160	.0012	.92	2.0
1907,	.54	12.95	2.83	.4607	.0864	.0525	.0339	2.94	.0352	.0021	.86	3.2
1908,	.48	10.81	3.48	.3925	.0598	.0347	.0251	1.79	.0218	.0049	.64	–
1909,	.50	12.66	4.07	.5658	.0479	.0399	.0080	1.89	.0273	.0064	.72	–
1910,	.57	15.21	3.83	.8038	.0640	.0499	.0141	3.01	.0248	.0082	.88	4.2
1911,	.58	14.12	3.64	.2881	.0447	.0323	.0124	2.51	.0785	.0114	.75	4.4
1912,	.47	15.99	3.24	.5413	.0480	.0370	.0110	2.67	.0880	.0101	.64	5.5
1913,	.58	13.58	3.65	.2918	.0536	.0361	.0175	1.94	.0505	.0108	.96	3.8
1914,	.48	12.47	2.87	.2817	.0470	.0368	.0102	1.74	.0298	.0085	.74	3.3
1915,	.72	12.00	3.58	.1327	.0587	.0344	.0243	1.61	–	–	1.04	3.1
1916,[4]	.41	12.26	4.96	.1258	.0251	.0220	.0031	1.93	–	–	.81	2.9
1917,	.32	17.93	5.77	.4138	.0413	.0321	.0092	3.24	–	–	.49	3.7

[1] November omitted. [2] Four months. [3] June omitted. [4] October omitted.

CHARLES RIVER.

Chemical Examination of Water from Charles River, etc. — *Concluded.*

Charles River, opposite Pumping Station of Brookline Water Works.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1887,	.83	5.37	1.62	.0013	.0282	–	–	.44	.0087	–	–	–
1888,	.98	4.87	1.92	.0014	.0264	.0240	.0024	.37	.0062	.0002	–	–
1895,	.74	4.91	2.08	.0004	.0237	.0207	.0030	.48	.0055	.0001	.75	1.5
1897,	1.02	5.36	2.45	.0012	.0288	.0262	.0026	.43	.0067	.0001	.86	1.5
1898,	.87	5.22	2.40	.0012	.0303	.0281	.0022	.39	.0035	.0001	.92	1.4
1899,	.46	5.03	1.92	.0011	.0262	.0230	.0032	.45	.0025	.0001	.62	1.5
1900,	.56	4.96	1.60	.0018	.0252	.0229	.0023	.46	.0020	.0000	.70	1.4
1901,	.92	5.45	2.60	.0020	.0314	.0275	.0039	.41	.0047	.0001	.95	1.4
1902,	.52	5.46	2.03	.0031	.0234	.0211	.0023	.57	.0045	.0001	.64	1.6
1903,	.71	6.22	2.30	.0031	.0240	.0223	.0017	.53	.0065	.0001	.80	1.5
1904,	.51	5.24	2.17	.0021	.0224	.0208	.0016	.55	.0060	.0001	.67	1.6
1905,[1]	.84	5.93	2.60	.0029	.0318	.0277	.0041	.54	.0056	.0002	.92	1.5
1906,[1]	1.05	6.00	2.77	.0039	.0294	.0267	.0027	.53	.0032	.0001	1.17	1.4
1907,[1]	.63	6.15	2.40	.0022	.0246	.0228	.0018	.64	.0026	.0001	.73	1.7
1908,[1]	.55	5.93	2.29	.0035	.0248	.0222	.0026	.65	.0036	.0002	.61	1.7
1909,[2]	.65	5.75	2.00	.0023	.0254	.0236	.0018	.69	.0015	.0001	.75	1.5
1910,	.60	6.71	2.79	.0028	.0289	.0260	.0029	.83	.0013	.0001	.72	1.8
1911,	.85	7.42	3.02	.0040	.0302	.0258	.0044	.80	.0032	.0001	1.10	2.0
1912,	.56	6.30	2.07	.0043	.0298	.0237	.0061	.85	.0012	.0001	.69	2.1
1913,	.74	7.32	2.27	.0053	.0342	.0300	.0042	.85	.0043	.0002	.86	2.0
1914,	.55	7.10	1.87	.0055	.0314	.0265	.0049	.92	.0032	.0001	.66	2.1
1916,[2]	.45	8.10	2.60	.0087	.0245	.0211	.0034	.96	–	–	.65	2.0
1917,	.70	7.93	2.72	.0053	.0394	.0270	.0124	.73	–	–	1.02	2.1

[1] Five months.

[2] Two months.

Charles River, opposite Pumping Station of Waltham Water Works.

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1887,	.67	6.02	1.62	.0029	.0274	–	–	.48	.0043	–	–	–
1888,	.82	5.47	1.88	.0035	.0310	.0265	.0045	.41	.0087	.0002	–	–
1897,	.95	6.06	2.45	.0056	.0322	.0299	.0023	.53	.0073	.0002	.83	1.9
1898,	.81	5.74	2.46	.0050	.0329	.0296	.0033	.44	.0043	.0001	.85	1.6
1899,	.41	5.50	1.81	.0047	.0264	.0248	.0016	.51	.0051	.0002	.52	1.9
1900,	.52	5.93	1.68	.0064	.0282	.0259	.0023	.53	.0070	.0002	.58	1.7
1901,	.82	5.93	2.72	.0065	.0322	.0289	.0033	.44	.0067	.0002	.85	1.8
1902,	.45	6.21	1.97	.0084	.0258	.0228	.0030	.62	.0077	.0003	.59	2.0
1903,	.64	6.06	2.21	.0078	.0267	.0239	.0028	.58	.0084	.0003	.71	2.0
1904,	.55	6.08	2.22	.0062	.0317	.0266	.0051	.62	.0095	.0002	.62	2.0
1905,	.79	6.29	2.54	.0077	.0363	.0308	.0055	.58	.0075	.0002	.80	1.7
1906,	1.00	6.70	2.58	.0063	.0335	.0297	.0038	.59	.0038	.0002	.98	1.8
1907,[1]	.58	6.22	2.24	.0067	.0278	.0247	.0031	.63	.0058	.0002	.65	2.0
1908,	.62	6.50	2.49	.0048	.0344	.0284	.0060	.69	.0027	.0001	.64	1.9
1909,	.54	6.79	2.36	.0063	.0349	.0298	.0051	.76	.0026	.0002	.53	2.0
1910,	.59	7.37	2.87	.0078	.0336	.0299	.0037	.81	.0037	.0003	.56	2.4
1911,	.75	7.47	2.95	.0086	.0343	.0308	.0035	.85	.0030	.0003	.87	2.3
1912,	.57	7.59	2.32	.0095	.0320	.0280	.0040	.92	.0038	.0002	.63	2.6
1913,[2]	.68	7.68	2.54	.0083	.0437	.0378	.0059	.91	.0041	.0003	.74	2.3
1914,	.52	7.45	1.98	.0117	.0353	.0297	.0056	.92	.0030	.0002	.57	2.6
1915,	.93	8.30	2.97	.0131	.0475	.0407	.0068	.91	–	–	1.11	2.3
1916,	.69	8.68	3.38	.0163	.0328	.0246	.0082	.89	–	–	.91	2.2
1917,	.67	7.68	2.75	.0109	.0310	.0282	.0028	.80	–	–	.71	2.3

[1] July omitted.

[2] June omitted.

CHICOPEE RIVER.

A general statement of the condition of this river and its tributaries during the year 1917 will be found on page 244.

CHICOPEE RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Ware River, below Ware.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898,	.64	4.42	1.94	.0028	.0332	.0250	.0082	.19	.0025	.0003	.77	1.0
1899,	.46	4.82	1.77	.0052	.0371	.0268	.0103	.25	.0015	.0004	.66	0.9
1900,	.51	4.93	1.64	.0066	.0321	.0243	.0078	.25	.0030	.0003	.73	1.1
1901,	.73	4.79	2.15	.0082	.0300	.0242	.0058	.18	.0044	.0002	.84	1.3
1902,	.76	4.86	2.17	.0071	.0348	.0252	.0096	.23	.0040	.0003	.93	1.0
1903,[1]	.68	4.83	2.18	.0072	.0345	.0240	.0105	.25	.0034	.0003	.78	0.8
1904,[1]	.60	5.60	2.36	.0043	.0411	.0285	.0126	.29	.0046	.0004	.72	1.1
1908,	.56	7.38	2.86	.0265	.0418	.0264	.0154	.37	.0033	.0005	.80	–
1909,[1]	.61	8.63	3.05	.0354	.0569	.0357	.0212	.44	.0015	.0006	.98	–
1910,	.57	9.82	4.39	.0655	.0622	.0426	.0196	.60	.0040	.0011	.84	–
1911,	.70	9.15	3.37	.0396	.0554	.0375	.0179	.48	.0015	.0003	.98	–
1912,	.62	10.93	3.23	.0592	.0717	.0491	.0226	.61	.0015	.0014	.95	–
1913,	.66	9.74	2.97	.0525	.0634	.0432	.0202	.51	.0023	.0005	.96	–
1914,	.60	10.47	3.15	.0501	.0704	.0488	.0216	.53	.0012	.0006	.82	–
1915,	.76	9.43	3.41	.0317	.0746	.0427	.0319	.42	–	–	1.16	–
1916,	.79	7.37	2.82	.0148	.0451	.0334	.0117	.36	–	–	1.04	–
1917,[2]	.53	8.38	2.68	.0529	.0630	.0376	.0254	.44	–	–	.74	–

[1] September omitted. [2] July omitted.

Quaboag River, below Palmer.

Year.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1899,	.35	4.54	1.68	.0048	.0252	.0208	.0044	.26	.0060	.0002	.44	1.1
1900,	.40	4.56	1.58	.0038	.0218	.0176	.0042	.26	.0062	.0001	.48	1.2
1901,	.42	4.32	1.74	.0043	.0255	.0202	.0053	.23	.0052	.0002	.53	1.1
1902,	.41	4.55	1.64	.0077	.0242	.0196	.0046	.33	.0085	.0002	.53	1.2
1903,	.44	4.36	1.67	.0090	.0242	.0186	.0056	.27	.0092	.0003	.51	1.0
1904,	.40	4.68	1.70	.0191	.0253	.0195	.0058	.31	.0082	.0002	.50	1.1
1908,	.36	5.31	1.98	.0061	.0207	.0149	.0058	.40	.0070	.0003	.42	–
1909,	.31	5.43	1.95	.0068	.0211	.0165	.0046	.41	.0058	.0003	.47	–
1910,	.44	6.05	2.28	.0043	.0238	.0168	.0070	.52	.0057	.0003	.73	–
1911,[1]	.39	5.94	2.08	.0060	.0191	.0145	.0046	.44	.0032	.0002	.53	–
1912,	.40	7.63	2.08	.0087	.0209	.0144	.0065	.46	.0068	.0001	.58	–
1913,[2]	.58	7.67	1.81	.0108	.0278	.0164	.0114	.46	.0042	.0001	.61	–
1914,	.49	6.62	1.62	.0144	.0243	.0176	.0067	.49	.0045	.0004	.35	–
1915,	.56	6.00	2.12	.0128	.0336	.0236	.0100	.40	–	–	.62	–
1916,	.64	6.02	2.54	.0134	.0278	.0209	.0069	.31	–	–	.70	–

[1] Four months. [2] June omitted.

CHICOPEE RIVER.

Chemical Examination of Water from Chicopee River and its Tributaries, etc. — *Concluded.*

Swift River, below Bondsville.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1908,[1]	.34	5.45	2.42	.0047	.0217	.0132	.0085	.21	.0013	.0002	.44	-
1909,[2]	.40	4.60	1.70	.0016	.0196	.0139	.0057	.22	.0000	.0001	.60	-
1910, ...	.33	5.28	2.05	.0031	.0261	.0196	.0065	.25	.0010	.0001	.60	-
1911, ...	.48	5.05	2.12	.0021	.0278	.0193	.0085	.21	.0007	.0000	.74	-
1912, ...	.28	5.02	1.92	.0047	.0268	.0184	.0084	.21	.0008	.0001	.54	-
1913, ...	.36	5.32	1.95	.0024	.0296	.0204	.0092	.26	.0008	.0001	.58	-
1914, ...	.35	4.97	1.67	.0037	.0304	.0219	.0085	.20	.0025	.0002	.55	-
1915, ...	.46	4.95	1.83	.0052	.0269	.0202	.0067	.24	-	-	.64	-
1916, ...	.49	4.22	1.67	.0026	.0193	.0160	.0033	.18	-	-	.69	-
1917, ...	.33	5.07	2.02	.0034	.0224	.0166	.0058	.19	-	-	.50	-

[1] Three months. [2] Two months.

Chicopee River, above Chicopee.

Year.	Color.	Residue: Total.	Residue: Loss on Ignition.	Ammonia: Free.	Albuminoid: Total.	Albuminoid: Dissolved.	Albuminoid: Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1908,[1]	.42	5.21	1.98	.0100	.0240	.0177	.0063	.33	.0056	.0003	.62	-
1909,[2]	.38	5.82	2.08	.0094	.0220	.0162	.0058	.36	.0046	.0004	.46	-
1910, ...	.45	6.14	2.06	.0099	.0239	.0191	.0048	.44	.0052	.0003	.50	-
1911, ...	.48	6.12	2.10	.0081	.0275	.0184	.0091	.42	.0067	.0004	.57	-
1912, ...	.41	6.83	2.03	.0159	.0287	.0221	.0066	.50	.0108	.0005	.47	-
1913, ...	.43	6.68	2.13	.0146	.0302	.0211	.0091	.44	.0067	.0006	.50	-
1914, ...	.33	6.50	2.00	.0163	.0278	.0212	.0066	.51	.0095	.0008	.40	-
1915, ...	.61	6.45	1.98	.0168	.0295	.0242	.0053	.39	-	-	.64	-
1916,[3]	.69	6.15	2.35	.0126	.0236	.0194	.0042	.32	-	-	.72	-
1917,[4]	.35	8.84	3.10	.0244	.0250	.0196	.0054	.36	-	-	.43	-

[1] October omitted. [2] September omitted. [3] Four months. [4] June omitted.

Concord River.

A general statement of the condition of this river and its tributaries during the year 1917 will be found on pages 244 and 245.

CONCORD RIVER.

Chemical Examination of Water from Concord River and its Tributaries. — Averages for Six Months, from June to November, inclusive.

Sudbury River, below Saxonville.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1901,	.84	7.22	3.37	.0073	.0624	.0431	.0193	.38	.0050	.0005	1.05	1.9
1902,	.38	6.39	2.57	.0150	.0424	.0272	.0152	.60	.0103	.0005	.55	2.2
1903,	.52	7.77	2.78	.0028	.0549	.0296	.0253	.65	.0080	.0002	.83	2.1
1904,	.48	9.58	3.57	.0569	.0587	.0385	.0202	.87	.0193	.0032	.88	2.5
1906,[1]	.67	6.88	2.90	.0258	.0525	.0381	.0144	.56	.0058	.0004	.92	1.9
1907,[2]	.65	9.07	3.28	.1357	.0653	.0347	.0306	.84	.0063	.0004	.84	2.1
1908,[3]	.44	9.67	3.72	.0039	.0634	.0374	.0260	1.06	.0128	.0009	.69	–
1909,	.43	6.81	2.59	.0174	.0330	.0256	.0074	.64	.0043	.0005	.64	–
1910,	.49	9.78	3.45	.0454	.0606	.0345	.0261	.83	.0040	.0010	.65	–
1911,	.37	9.03	3.08	.0287	.0410	.0281	.0129	.92	.0120	.0009	.54	–
1912,	.49	8.83	2.75	.0238	.0366	.0253	.0113	1.19	.0137	.0031	.72	–
1913,	.69	7.28	2.56	.0152	.0347	.0291	.0056	.90	.0185	.0023	.77	–
1914,	.51	9.62	3.03	.0292	.0439	.0276	.0163	1.13	.0220	.0042	.61	–
1915,	.97	6.67	2.75	.0129	.0408	.0319	.0089	.73	–	–	1.04	–
1916,[1]	.62	7.20	2.10	.0315	.0311	.0264	.0047	.93	–	–	.74	–
1917,	.52	7.30	2.70	.0185	.0481	.0306	.0175	.63	–	–	.73	–

[1] June omitted. [2] Three months. [3] August omitted.

Assabet River, above Westborough.

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1909,	.56	6.01	2.20	.0048	.0217	.0194	.0023	.36	.0015	.0001	.69	–
1910,	.90	7.37	3.12	.0029	.0251	.0229	.0022	.38	.0035	.0001	.86	–
1911,	.97	8.02	3.39	.0061	.0441	.0354	.0087	.45	.0023	.0002	1.20	–
1912,	.72	7.00	2.36	.0073	.0255	.0228	.0027	.44	.0061	.0002	.87	–
1913,	1.25	8.26	3.73	.0095	.0469	.0392	.0077	.46	.0007	.0002	1.55	–
1914,	.92	7.37	2.78	.0088	.0356	.0304	.0052	.41	.0034	.0001	.98	–
1915,	1.56	8.08	4.02	.0046	.0453	.0406	.0047	.46	–	–	1.74	–
1916,	1.01	7.52	3.20	.0033	.0298	.0260	.0038	.47	–	–	1.24	–
1917,	.82	8.11	3.43	.0088	.0325	.0281	.0044	.57	–	–	1.11	–

CONCORD RIVER.

Chemical Examination of Water from Concord River and its Tributaries, etc. — *Continued.*

Assabet River, below Westborough.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1909, ...	1.70	19.24	8.91	.4140	.2281	.1616	.0665	1.94	.0005	.0005	2.90	-
1910, ...	2.23	17.07	7.00	.2898	.1334	.1018	.0316	2.16	.0078	.0018	2.20	-
1911, ...	.83	12.09	4.01	.0556	.0460	.0373	.0087	1.87	.0967	.0121	1.24	-
1912, ...	.66	12.71	4.01	.0975	.0419	.0357	.0062	2.20	.1998	.0132	.95	-
1913, ...	1.15	9.67	4.21	.0152	.0448	.0401	.0047	1.08	.1078	.0016	1.37	-
1914, ...	.80	10.21	3.14	.0089	.0399	.0339	.0060	1.59	.0195	.0005	1.01	-
1915, ...	1.62	9.46	4.28	.0118	.0539	.0438	.0101	.87	-	-	1.83	-
1916, ...	.88	11.30	4.38	.0807	.0360	.0319	.0041	1.87	-	-	1.12	-
1917, ...	.80	10.08	3.68	.0428	.0381	.0352	.0029	1.03	-	-	1.04	-

Assabet River, above Hudson.

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1908,[1]	.49	5.97	2.16	.0044	.0241	.0200	.0041	.54	.0072	.0003	.59	-
1909, ...	.39	6.37	2.33	.0070	.0306	.0261	.0045	.52	.0037	.0002	.50	-
1910, ...	.57	6.90	3.08	.0058	.0346	.0296	.0050	.61	.0055	.0002	.67	-
1911, ...	.57	6.82	2.51	.0059	.0295	.0248	.0047	.57	.0077	.0002	.81	-
1912, ...	.45	6.51	2.13	.0075	.0297	.0234	.0063	.62	.0108	.0002	.59	-
1913,[2]	.65	8.48	2.81	.0168	.0386	.0327	.0059	.70	.0046	.0002	.79	-
1914, ...	.44	6.80	2.10	.0066	.0275	.0222	.0053	.65	.0060	.0001	.53	-
1915, ...	.82	6.48	2.63	.0064	.0325	.0305	.0020	.55	-	-	1.02	-
1916, ...	.54	6.68	2.73	.0053	.0236	.0208	.0028	.61	-	-	.62	-
1917, ...	.50	6.64	2.26	.0057	.0288	.0223	.0065	.55	-	-	.57	-

[1] September omitted.

[2] November omitted.

CONCORD RIVER.

Chemical Examination of Water from Concord River and its Tributaries, etc. — *Continued.*

Assabet River, below Hudson.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
				Free.	Albuminoid.							
		Total.	Loss on Ignition.		Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898	.79	5.61	2.38	.0062	.0335	.0291	.0044	.39	.0063	.0003	.87	1.6
1899	.50	8.30	3.01	.0205	.0457	.0383	.0074	.80	.0020	.0004	.73	2.1
1900	.48	8.05	2.05	.0382	.0501	.0362	.0139	1.27	.0028	.0007	.72	2.0
1901	.66	5.47	2.38	.0193	.0375	.0295	.0080	.79	.0107	.0005	.91	1.8
1902	.64	7.06	2.69	.0189	.0464	.0330	.0134	.84	.0077	.0005	.74	1.9
1903[1]	.51	5.71	2.17	.0092	.0287	.0222	.0065	.56	.0073	.0006	.60	1.7
1904[2]	.44	7.67	2.60	.0329	.0375	.0312	.0063	1.43	.0073	.0005	.64	1.9
1908	.51	9.17	3.50	.0198	.0396	.0294	.0102	1.32	.0072	.0005	.82	–
1909	.51	8.81	3.26	.0161	.0403	.0296	.0107	.98	.0022	.0002	.64	–
1910	.69	13.83	3.83	.0413	.0428	.0337	.0091	1.27	.0048	.0002	1.24	–
1911	.64	12.83	4.30	.0817	.0532	.0400	.0132	.90	.0043	.0003	1.06	–
1912	.78	18.08	3.99	.0939	.0752	.0494	.0258	1.02	.0053	.0002	1.28	–
1913[3]	.76	13.29	3.34	.0727	.0704	.0577	.0127	1.07	.0036	.0004	1.28	–
1914	.57	11.88	3.10	.0720	.0601	.0436	.0165	.98	.0042	.0002	1.03	–
1915	.90	8.25	3.17	.0144	.0466	.0356	.0110	.59	–	–	1.16	–
1916	.64	11.03	3.95	.0398	.0509	.0377	.0132	.70	–	–	.89	–
1917	.63	10.36	3.57	.0250	.0522	.0376	.0146	.65	–	–	.77	–

[1] June omitted. [2] Three months. [3] November omitted.

Assabet River, above Maynard.

1904	.53	5.65	2.30	.0046	.0275	.0231	.0044	.64	.0035	.0001	.63	1.6
1906	.75	5.53	2.26	.0065	.0290	.0254	.0036	.48	.0035	.0002	.97	1.5
1907[1]	.68	5.35	1.80	.0047	.0255	.0211	.0044	.50	.0043	.0002	.73	1.6
1908	.52	6.91	2.32	.0093	.0288	.0248	.0040	1.03	.0030	.0002	.62	–
1909	.43	6.18	2.13	.0068	.0343	.0277	.0066	.72	.0023	.0001	.62	–
1910	.54	7.70	2.82	.0098	.0337	.0291	.0046	.98	.0017	.0003	.64	–
1911	.57	7.67	2.33	.0087	.0327	.0277	.0050	.85	.0065	.0004	.73	–
1912	.57	7.92	2.15	.0058	.0316	.0242	.0074	1.06	.0032	.0002	.65	–
1913	.60	7.85	2.27	.0085	.0372	.0296	.0076	1.03	.0028	.0003	.73	–
1914	.46	7.02	2.39	.0069	.0373	.0308	.0065	.82	.0014	.0002	.53	–
1915	.92	7.08	2.63	.0104	.0403	.0336	.0067	.63	–	–	1.03	–
1916	.64	7.25	2.47	.0127	.0302	.0260	.0042	.67	–	–	.81	–
1917	.57	7.95	2.57	.0204	.0361	.0276	.0085	.63	–	–	.68	–

[1] Four months.

CONCORD RIVER.

Chemical Examination of Water from Concord River and its Tributaries, etc. — *Concluded.*

Assabet River, below Maynard.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1898,	.77	5.93	2.59	.0020	.0387	.0301	.0086	.43	.0030	.0003	.89	1.5
1899,	.51	6.70	2.21	.0185	.0414	.0327	.0087	.73	.0043	.0003	.62	1.7
1900,	.50	5.72	1.73	.0217	.0386	.0304	.0082	.70	.0031	.0002	.59	1.4
1901,	.73	6.57	2.67	.0211	.0428	.0351	.0077	.45	.0052	.0002	.90	1.6
1902,	.69	7.27	2.87	.0099	.0592	.0381	.0211	.57	.0033	.0002	.83	1.6
1903,	.61	6.40	2.58	.0170	.0 57	.0322	.0135	.48	.0037	.0003	.83	1.6
1904,	–	8.48	3.21	.0143	.0678	.0412	.0266	.74	.0043	.0002	1.05	1.7
1906,	.88	6.68	2.64	.0290	.0448	.0312	.0136	.58	.0047	.0003	.91	1.6
1907,[1]	.79	7.64	2.76	.0299	.0391	.0274	.0117	.69	.0060	.0003	.86	1.6
1908,	.45	11.46	3.98	.0675	.0684	.0381	.0303	1.37	.0028	.0012	.89	–
1909,	–	13.97	4.21	.1208	.0991	.0529	.0462	1.22	.0007	.0006	1.34	–
1910,	.59	13.15	4.68	.0708	.0685	.0446	.0239	1.82	.0038	.0006	.85	–
1911,	.58	12.73	4.17	.0738	.0650	.0408	.0242	1.41	.0060	.0006	1.08	–
1912,	–	12.94	3.92	.1205	.0771	.0494	.0277	1.46	.0026	.0010	1.04	–
1913,	.60	10.60	3.01	.0746	.0597	.0394	.0203	1.34	.0311	.0007	.85	–
1914,	.33	11.58	2.87	.0705	.0595	.0378	.0217	1.32	.0056	.0012	.73	–
1915,	.69	10.78	3.25	.0509	.0610	.0353	.0257	1.27	–	–	.99	–
1916,	.83	11.27	3.98	.0191	.0576	.0364	.0212	1.13	–	–	1.32	–
1917,	.67	12.08	4.14	.0684	.0832	.0440	.0392	1.30	–	–	1.07	–

[1] Four months.

Concord River, at Billerica.

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Hardness.
1902,	.68	5.98	2.18	.0091	.0347	.0272	.0075	.53	.0052	.0004	.78	1.7
1903,	.64	5.71	2.26	.0097	.0317	.0258	.0059	.49	.0058	.0005	.72	1.8
1904,	.64	6.05	2.31	.0077	.0341	.0255	.0086	.55	.0072	.0002	.75	1.7
1908,	.37	8.04	2.65	.0107	.0251	.0216	.0035	.96	.0104	.0005	.54	–
1909,	.49	7.71	2.78	.0128	.0298	.0267	.0031	.75	.0058	.0013	.65	–
1910,	.49	7.31	3.00	.0142	.0325	.0292	.0033	1.01	.0055	.0004	.58	–
1911,	.45	11.14	4.05	.0181	.0525	.0287	.0238	1.16	.0132	.0008	1.14	–
1912,[1]	.53	10.90	3.08	.0187	.0433	.0274	.0159	.97	.0140	.0008	.82	–
1913,	.57	7.63	2.38	.0089	.0355	.0312	.0043	.98	.0073	.0003	.77	–
1914,	.41	8.78	2.20	.0096	.0335	.0284	.0051	1.10	.0072	.0005	.50	–
1915,	.88	7.92	2.93	.0157	.0411	.0375	.0036	.84	–	–	1.05	–
1916,	.62	8.60	2.87	.0130	.0292	.0256	.0036	.85	–	–	.78	–
1917,	.54	7.42	2.32	.0166	.0321	.0268	.0053	.94	–	–	.55	–

[1] September omitted.

Connecticut River.

A general statement of the condition of this river during the year 1917 will be found on page 245.

CONNECTICUT RIVER.

Chemical Examination of Water from Connecticut River. — Averages for Six Months, from June to November, inclusive.

Connecticut River, at Northfield Farms.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899,	.30	7.32	2.17	.0016	.0189	.0158	.0031	.11	.0023	.0001	.85	3.6
1900,	.47	6.24	2.11	.0023	.0190	.0154	.0036	.09	.0030	.0001	.95	2.9
1901,	.31	6.12	2.39	.0016	.0146	.0122	.0024	.10	.0037	.0002	.72	3.2
1902,	.30	5.57	2.02	.0014	.0124	.0110	.0014	.08	.0057	.0001	.60	2.9
1903,	.23	6.83	2.18	.0037	.0169	.0143	.0026	.14	.0028	.0002	.68	3.4
1904,[1]	.27	6.44	2.44	.0023	.0158	.0130	.0028	.12	.0038	.0001	.73	3.4
1906,	.34	6.50	2.17	.0040	.0201	.0181	.0020	.14	.0023	.0002	.76	3.2
1907,[2]	.36	5.91	2.06	.0020	.0141	.0122	.0019	.16	.0048	.0002	.66	3.0
1908,[3]	.28	8.33	2.78	.0058	.0200	.0177	.0023	.22	.0018	.0001	.70	–
1909,	.29	7.32	2.89	.0031	.0142	.0124	.0018	.16	.0017	.0002	.82	–
1910,	.31	7.52	3.10	.0064	.0174	.0152	.0022	.17	.0018	.0001	.77	–
1911,	.32	7.28	2.44	.0066	.0172	.0143	.0029	.16	.0022	.0001	.70	–
1912,	.36	7.43	1.63	.0066	.0185	.0148	.0037	.16	.0012	.0001	.70	–
1913,	.31	7.78	2.31	.0077	.0174	.0131	.0043	.17	.0020	.0002	.65	–
1914,	.29	8.03	2.73	.0056	.0182	.0137	.0045	.17	.0012	.0001	.70	–
1915,	.30	7.08	2.08	.0031	.0162	.0124	.0038	.17	–	–	.60	–
1916,[4]	.37	6.90	2.10	.0032	.0152	.0135	.0017	.14	–	–	.80	–
1917,[4]	.35	7.40	3.08	.0055	.0196	.0139	.0057	.13	–	–	.63	–

[1] July omitted. [2] Four months. [3] June omitted. [4] August omitted.

Connecticut River, below Springfield.

Year.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1888,	.35	5.34	1.24	.0032	.0182	.0143	.0039	.15	.0082	.0002	–	–
1899,	.33	6.61	1.99	.0093	.0238	.0195	.0043	.23	.0042	.0003	.67	3.1
1900,	.44	6.64	1.90	.0098	.0250	.0176	.0074	.20	.0034	.0002	.89	3.1
1901,	.32	6.03	2.34	.0061	.0190	.0153	.0037	.18	.0048	.0003	.65	3.0
1902,	.31	5.83	2.13	.0062	.0180	.0140	.0040	.16	.0055	.0005	.61	3.0
1903,	.30	6.12	2.04	.0098	.0202	.0147	.0055	.24	.0058	.0004	.61	2.7
1904,[1]	.22	5.22	1.87	.0098	.0187	.0125	.0062	.21	.0047	.0002	.48	2.4
1906,[2]	.35	7.14	2.61	.0082	.0204	.0161	.0043	.24	.0026	.0004	.71	2.8
1907,[3]	.38	6.27	2.46	.0069	.0163	.0131	.0032	.24	.0050	.0003	.67	2.9
1908,	.32	8.58	2.61	.0214	.0223	.0165	.0058	.38	.0040	.0004	.81	–
1909,	.29	6.02	2.25	.0079	.0156	.0118	.0038	.22	.0018	.0003	.65	–
1910,	.33	8.67	3.60	.0155	.0241	.0188	.0053	.37	.0028	.0003	.89	–
1911,	.38	7.66	2.56	.0140	.0181	.0147	.0034	.28	.0018	.0005	.70	–
1912,	.31	8.22	3.02	.0136	.0228	.0161	.0067	.16	.0022	.0004	.74	–
1913,[4]	.31	7.96	2.50	.0178	.0242	.0181	.0061	.35	.0038	.0004	.68	–
1914,	.29	7.92	2.50	.0185	.0243	.0178	.0065	.30	.0023	.0003	.82	–
1915,	.35	7.15	2.38	.0091	.0216	.0151	.0065	.24	–	–	.69	–
1916,	.37	7.82	3.09	.0067	.0173	.0143	.0030	.20	–	–	.77	–
1917,	.36	8.30	3.30	.0106	.0227	.0174	.0053	.22	–	–	.67	–

[1] Three months. [2] June omitted. [3] Four months. [4] September omitted.

Deerfield River.

A general statement of the condition of this river in the year 1917 will be found on page 245.

DEERFIELD RIVER.

Chemical Examination of Water from Deerfield River and Tributary. — Averages for Six Months, from June to November, inclusive.

Deerfield River, at Shelburne Falls.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1901,	.34	4.02	1.82	.0057	.0200	.0171	.0029	.09	.0078	.0001	.63	1.7
1902,	.29	3.62	1.46	.0051	.0151	.0126	.0025	.08	.0055	.0002	.51	1.7
1903,[1]	.26	3.74	1.35	.0023	.0131	.0113	.0018	.09	.0038	.0002	.44	1.5
1904,	.24	4.15	1.52	.0040	.0115	.0097	.0018	.11	.0110	.0001	.39	2.1
1908,	.33	4.93	1.93	.0017	.0128	.0108	.0020	.14	0030	.0001	.44	–
1909,	.26	4.56	1.62	.0009	.0150	.0129	.0021	.12	.0005	.0001	.47	–
1910,	.26	4.62	1.69	.0025	.0141	.0108	.0033	.13	.0010	.0001	.45	–
1911,	.35	4.80	1.88	.0035	.0156	.0119	.0037	.13	.0027	.0000	.59	–
1912,[2]	.29	4.48	1.65	.0024	.0149	.0122	.0027	.11	.0008	.0001	.42	–
1913,	.39	4.55	1.30	.0049	.0213	.0164	.0049	.12	.0007	.0000	.53	–
1914,	.45	4.80	1.57	.0062	.0222	.0167	.0055	.17	.0022	.0003	.56	–
1915,	.27	4.58	1.44	.0042	.0149	.0121	.0028	.16	–	–	.39	–
1916,[1]	.34	4.50	2.23	.0033	.0129	.0117	.0012	.23	–	–	.55	–
1917,[3]	.22	4.97	1.90	.0035	.0113	.0093	.0020	.12	–	–	.20	–

[1] Four months. [2] October omitted. [3] Three months.

DEERFIELD RIVER.

Chemical Examination of Water from Deerfield River and Tributary, etc. — *Concluded.*

Green River, below Greenfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1903,	.05	7.75	2.23	.0152	.0143	.0086	.0057	.21	.0078	.0005	.15	3.9
1904,	.07	6.93	2.01	.0151	.0382	.0138	.0244	.28	.0100	.0006	.22	3.8
1908,	.17	11.06	2.97	.0665	.0337	.0131	.0206	.45	.0043	.0011	.33	–
1909,	.14	7.82	2.54	.0459	.0333	.0151	.0182	.37	.0038	.0011	.23	–
1910,	.17	8.33	3.16	.0775	.0284	.0169	.0115	.37	.0025	.0012	.23	–
1911,	.21	9.23	2.44	.0684	.0228	.0115	.0113	.48	.0033	.0014	.37	–
1812,	.17	18.02	2.71	.0099	.0352	.0092	.0260	.23	.0017	.0003	.44	–
1913,	.12	8.25	2.25	.0203	.0198	.0103	.0095	.26	.0030	.0003	.22	–
1914,	.13	9.15	1.60	.0426	.0234	.0135	.0099	.38	.0038	.0007	.17	–
1915,[1]	.10	6.95	1.15	.0348	.0184	.0102	.0082	.28	–	–	.20	–
1916,	.08	10.26	2.42	.0284	.0161	.0084	.0077	.34	–	–	.22	–

[1] Four months.

Deerfield River, below Green River.

1908,	.26	7.35	2.28	.0075	.0154	.0098	.0056	.20	.0025	.0002	.37	–
1909,	.28	5.55	1.83	.0043	.0121	.0104	.0017	.14	.0012	.0001	.41	–
1910,	.24	5.82	2.37	.0093	.0128	.0112	.0016	.16	.0008	.0003	.31	–
1911,	.34	5.82	2.06	.0078	.0143	.0106	.0037	.16	.0025	.0005	.52	–
1912,	.25	5.23	1.63	.0070	.0140	.0107	.0033	.17	.0030	.0001	.37	–
1913,	.28	5.39	1.60	.0113	.0257	.0183	.0074	.17	.0063	.0002	.39	–
1914,	.30	5.68	1.80	.0124	.0182	.0143	.0039	.19	.0020	.0001	.43	–
1915,[1]	.22	5.41	1.28	.0211	.0195	.0128	.0067	.20	–	–	.34	–
1916,	.29	5.60	1.47	.0226	.0160	.0127	.0033	.21	–	–	.43	–
1917,[2]	.24	8.68	2.90	.0161	.0187	.0148	.0039	.20	–	–	.36	–

[1] Four months. [2] August omitted.

French River.

A general statement of the condition of this river in the year 1917 will be found on page 245.

FRENCH RIVER.

Chemical Examination of Water from French River. — Averages for Six Months, from June to November, inclusive.

French River, below Webster.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899,	.44	5.67	2.07	.0238	.0612	.0384	.0228	.42	.0024	.0007	.66	1.6
1900,	.52	5.79	2.10	.0202	.0475	.0357	.0118	.46	.0062	.0007	.78	1.5
1901,	.50	5.29	2.25	.0090	.0390	.0265	.0125	.33	.0044	.0002	.75	1.2
1902,	.42	4.92	1.99	.0057	.0391	.0264	.0127	.39	.0038	.0002	.65	1.2
1903,	.48	4.67	1.88	.0049	.0352	.0241	.0111	.40	.0058	.0002	.72	0.9
1904,	.44	6.02	2.18	.0267	.0434	.0281	.0153	.58	.0042	.0004	.70	1.3
1906,	.61	5.08	2.19	.0063	.0353	.0246	.0107	.40	.0038	.0003	.81	0.9
1907,[1]	.54	6.28	2.62	.0117	.0544	.0304	.0240	.49	.0035	.0004	.69	1.2
1908,	.44	7.17	2.82	.0086	.0507	.0310	.0197	.61	.0037	.0010	.81	–
1909,	.50	7.42	2.61	.0267	.0638	.0385	.0253	.77	.0055	.0012	.72	–
1910,	.44	8.27	3.55	.0512	.0527	.0321	.0206	.78	.0016	.0021	.79	–
1911,[1]	.57	10.23	3.17	.0219	.0652	.0405	.0247	.89	.0015	.0004	.94	–
1912,	.49	9.78	3.77	.0420	.0745	.0399	.0346	.82	.0060	.0021	.87	–
1913,	.53	8.42	2.93	.0345	.0641	.0358	.0283	.72	.0042	.0007	.86	–
1914,	.40	8.50	2.48	.0500	.0675	.0399	.0276	.72	.0018	.0027	.69	–
1915,	.53	8.38	3.02	.0472	.0778	.0448	.0330	.80	–	–	.88	–
1916,	.60	8.03	2.55	.0521	.0593	.0402	.0191	.84	–	–	.86	–
1917,	.48	7.85	3.08	.0428	.0645	.0367	.0278	.61	–	–	.72	–

[1] Four months.

Hoosick River.

A general statement of the condition of this river in the year 1917 will be found on page 246.

HOOSICK RIVER.

Chemical Examination of Water from Hoosick River. — Averages for Six Months, from June to November, inclusive.

Hoosick River, at Williamstown.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1887,	.22	12.05	1.22	.0065	.0190	–	–	.23	.0232	–	–	–
1888,	.12	10.82	1.90	.0026	.0210	.0142	.0068	.27	.0247	.0015	–	–
1894,	.37	13.56	2.74	.0166	.0361	.0224	.0137	.50	.0102	.0014	.42	9.0
1895,	.34	14.20	3.26	.0190	.0424	.0241	.0183	.63	.0090	.0020	.53	9.0
1896,	.21	11.71	2.39	.0295	.0267	.0172	.0095	.39	.0133	.0018	.33	8.6
1897,	.26	11.32	2.39	.0174	.0312	.0173	.0139	.30	.0265	.0011	.31	7.9
1898,	.27	10.46	2.38	.0223	.0311	.0210	.0101	.31	.0170	.0007	.34	6.6
1899,	.30	15.21	3.31	.0252	.0622	.0379	.0243	.64	.0070	.0029	.62	8.3
1900,	.28	14.20	2.79	.0433	.0547	.0301	.0246	.60	.0087	.0043	.58	7.8
1901,	.27	13.02	3.70	.0400	.0520	.0250	.0270	.43	.0152	.0024	.53	7.3
1902,	.22	10.62	2.87	.0069	.0307	.0172	.0135	.34	.0123	.0014	.40	6.4
1903,	.17	10.50	2.37	.0272	.0264	.0151	.0113	.29	.0183	.0019	.33	7.5
1904,	.13	12.30	3.23	.0677	.0310	.0191	.0119	.45	.0203	.0024	.29	8.3
1905,	.20	11.09	2.81	.0295	.0265	.0156	.0109	.32	.0123	.0015	.31	5.6
1906,	.31	13.28	3.63	.0415	.0489	.0252	.0237	.47	.0147	.0030	.43	6.0
1907,	.25	11.80	2.93	.0431	.0390	.0231	.0159	.47	.0135	.0021	.39	7.9
1908,	.23	14.00	3.86	.0559	.0323	.0195	.0128	.54	.0085	.0023	.37	–
1909,	.23	15.46	4.09	.0496	.0382	.0243	.0139	.62	.0060	.0035	.41	–
1910,	.30	13.06	4.43	.0320	.0336	.0219	.0117	.52	.0102	.0018	.41	–
1911,	.26	12.38	3.77	.1153	.0492	.0232	.0260	.58	.0065	.0022	.43	–
1912,	.24	15.05	3.35	.0365	.0464	.0280	.0184	.73	.0058	.0025	.45	9.3
1913,	.13	17.57	3.78	.0638	.0489	.0310	.0179	.88	.0053	.0024	.49	9.2
1914,	.39	18.62	4.02	.0670	.0584	.0381	.0203	.83	.0037	.0015	.63	9.5
1915,	.21	12.65	2.60	.0351	.0316	.0202	.0114	.49	–	–	.32	6.9
1916,[1]	.29	12.93	4.10	.0422	.0294	.0195	.0099	.67	–	–	.40	7.2
1917,[1]	.22	14.54	4.96	.0585	.0328	.0197	.0131	.59	–	–	.35	–

[1] August omitted.

Housatonic River.

A general statement of the condition of this river in the year 1917 will be found on page 246.

HOUSATONIC RIVER.

Chemical Examination of Water from Housatonic River and its Branches. — Averages for Six Months, from June to November, inclusive.

East Branch, below Pittsfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1903,	.32	9.75	2.92	.0118	.0226	.0153	.0073	.25	.0142	.0006	.56	6.8
1904,[1]	.28	9.02	3.15	.0117	.0248	.0175	.0073	.26	.0113	.0005	.47	6.2
1907,[2]	.42	9.40	3.00	.0286	.0284	.0186	.0098	.28	.0060	.0010	.50	6.4
1908,[3]	.29	12.76	3.57	.0327	.0250	.0177	.0073	.40	.0140	.0011	.47	–
1909,	.26	12.60	4.37	.0431	.0305	.0215	.0090	.33	.0087	.0007	.44	–
1910,	.30	12.98	5.26	.0437	.0233	.0182	.0051	.40	.0080	.0012	.48	–
1911,[1]	.29	12.03	4.26	.0231	.0253	.0169	.0084	.37	.0060	.0011	.54	–
1912,[1]	.28	13.08	3.18	.0358	.0337	.0236	.0101	.43	.0123	.0010	.62	–
1913,	.32	15.34	3.60	.0526	.0405	.0259	.0146	.48	.0073	.0019	.69	–
1914,[4]	.24	13.82	3.27	.0509	.0351	.0271	.0080	.47	.0087	.0015	.53	–
1915,	.37	11.98	3.23	.0527	.0304	.0236	.0068	.35	–	–	.60	–
1916,	.34	12.67	4.00	.0496	.0292	.0225	.0067	.40	–	–	.54	–
1917,	.07	11.41	3.38	.0228	.0247	.0159	.0088	.22	–	–	.31	–

[1] Three months. [2] Two months. [3] November omitted. [4] Four months.

West Branch, below Pittsfield.

1903,	.29	10.43	2.83	.0100	.0210	.0143	.0067	.23	.0143	.0006	.46	7.4
1904,[1]	.15	12.27	3.50	.0137	.0423	.0217	.0206	.35	.0050	.0004	.35	7.8
1908,[2]	.20	13.28	3.68	.0210	.0301	.0194	.0107	.26	.0026	.0009	.36	–
1909,	–	11.00	2.87	.0070	.0283	.0175	.0108	.24	.0010	.0003	.25	–
1910,	.22	13.85	4.98	.0218	.0446	.0218	.0228	.40	.0012	.0011	.40	–
1911,[1]	.19	12.73	4.70	.0090	0317	.0184	.0133	.26	.0030	.0005	.37	–
1912,[1]	.17	12.60	2.70	.0081	.0360	.0197	.0163	.29	.0037	.0005	.41	–
1913,	.30	18.72	5.10	.0870	.0779	.0397	.0382	.78	.0020	.0008	.82	–
1914,[3]	.20	14.62	2.75	.0288	0495	.0313	.0182	.45	.0017	.0011	.61	–
1915,[4]	.34	16.62	3.72	.0671	.0691	.0359	.0332	.65	–	–	.63	–
1916,	.18	12.93	3.78	.0568	.0432	.0228	.0204	.46	–	–	.29	–
1917,	.20	14.00	4.43	.0429	.0378	.0204	.0174	.38	–	–	.49	–

[1] Three months. [2] November omitted. [3] Four months. [4] September omitted.

HOUSATONIC RIVER.

Chemical Examination of Water from Housatonic River and its Branches, etc. — *Concluded.*

Southwest Branch, at Pittsfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1899,	.17	14.92	2.58	.0040	.0353	.0211	.0142	.16	.0108	.0004	.37	9.2
1900,	.14	14.87	2.15	.0192	.0335	.0229	.0106	.21	.0107	.0008	.35	10.2
1901,	.14	13.20	3.87	.0051	.0302	.0197	.0105	.16	.0096	.0004	.41	9.4
1902,	.11	12.30	3.09	.0057	.0224	.0136	.0088	.12	.0108	.0005	.37	8.7
1903,	.10	11.63	2.37	.0045	.0162	.0109	.0053	.11	.0115	.0003	.25	8.8
1904,[1]	.15	12.45	3.63	.0116	.0455	.0223	.0232	.34	.0040	.0018	.35	7.8
1907,[2]	.31	10.78	2.30	.0040	.0258	.0168	.0090	.20	.0025	.0003	.39	8.2
1908,[3]	.18	15.17	4.89	.0216	.0269	.0159	.0110	.23	.0036	.0007	.38	–
1909,	.17	14.82	4.41	.0041	.0265	.0153	.0112	.23	.0082	.0005	.37	–
1910,	.17	14.45	5.25	.0049	.0196	.0135	.0061	.17	.0045	.0006	.30	–
1911,[1]	.14	12.62	3.35	.0013	.0224	.0131	.0093	.19	.0110	.0005	.34	–
1912,[1]	.12	15.02	3.08	.0017	.0172	.0111	.0061	.21	.0170	.0007	.31	–
1913,	.13	15.97	3.34	.0037	.0221	.0157	.0064	.20	.0115	.0009	.32	–
1914,[4]	.16	15.05	2.30	.0098	.0259	.0166	.0093	.24	.0072	.0005	.37	–
1915,	.14	15.25	2.95	.0070	.0243	.0159	.0084	.26	–	–	.30	–
1916,	.15	14.97	4.69	.0038	.0197	.0122	.0075	.20	–	–	.30	–
1917,	.17	16.98	4.30	.0326	.0292	.0172	.0120	.36	–	–	.35	–

[1] Three months. [2] Two months. [3] November omitted. [4] Four months.

Housatonic River, below Great Barrington.

Year.	Color.	Residue Total.	Loss on Ignition.	Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1908,	.18	14.97	3.69	.0106	.0269	.0172	.0097	.43	.0107	.0011	.36	–
1909,	.16	14.91	4.41	.0067	.0247	.0173	.0074	.47	.0078	.0012	.35	–
1910,	.22	14.97	5.32	.0128	.0233	.0181	.0052	.51	.0090	.0021	.34	–
1911,	.19	14.42	5.29	.0178	.0217	.0157	.0060	.45	.0087	.0045	.40	–
1912,[1]	.22	14.56	3.79	.0123	.0272	.0189	.0083	.47	.0120	.0028	.42	–
1913,	.21	18.60	5.48	.0117	.0444	.0265	.0179	.67	.0085	.0030	.77	–
1914,[2]	.22	17.62	4.22	.0147	.0372	.0268	.0104	.69	.0112	.0023	.42	–
1915,	.23	15.83	3.60	.0142	.0296	.0183	.0113	.46	–	–	.47	–
1916,[3]	.22	15.40	5.80	.0143	.0230	.0174	.0056	.49	–	–	.40	–
1917,[4]	.19	15.76	4.30	.0130	.0295	.0196	.0099	.52	–	–	.43	–

[1] August omitted. [2] Four months. [3] June omitted. [4] September omitted.

Merrimack River.

A general statement of the condition of this river during the year 1917 will be found on page 246.

MERRIMACK RIVER.

Chemical Examination of Water from Merrimack River. — Averages for Six Months, from June to November, inclusive.

Merrimack River, above Lowell.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1887,	.45	4.08	1.10	.0024	.0156	–	–	.17	.0078	–	–	–
1888,	.32	3.47	1.01	.0014	.0161	.0137	.0024	.16	.0082	.0002	–	–
1889,	.37	–	–	.0028	.0166	.0143	.0023	.17	.0067	.0001	–	–
1890,	.34	3.85	1.58	.0025	.0148	.0123	.0025	.14	.0106	.0002	–	1.4
1891,	.27	3.73	1.47	.0029	.0147	.0111	.0036	.17	.0080	.0002	–	1.4
1892,	.39	3.75	1.37	.0028	.0139	.0106	.0033	.15	.0097	.0002	–	1.6
1893,	.25	3.47	1.13	.0028	.0141	.0110	.0031	.17	.0072	.0001	.38	1.1
1894,	.29	3.86	1.32	.0037	.0140	.0114	.0026	.19	.0042	.0001	.36	1.2
1895,	.43	3.97	1.61	.0019	.0197	.0151	.0046	.24	.0054	.0001	.55	1.2
1896,	.44	3.85	1.41	.0049	.0181	.0149	.0032	.18	.0053	.0002	.66	1.0
1897,	.54	3.62	1.68	.0030	.0181	.0148	.0033	.16	.0077	.0001	.52	0.9
1898,	.39	3.93	1.74	.0032	.0197	.0171	.0026	.19	.0047	.0001	.51	1.0
1899,	.20	3.88	1.45	.0050	.0205	.0166	.0039	.22	.0055	.0002	.38	1.2
1900,	.23	3.72	1.21	.0068	.0215	.0158	.0057	.23	.0038	.0002	.44	1.3
1901,	.38	4.32	1.98	.0060	.0208	.0172	.0036	.20	.0042	.0002	.69	1.2
1902,	.38	3.81	1.59	.0056	.0163	.0142	.0021	.17	.0043	.0001	.64	0.9
1903,	.30	4.00	1.55	.0058	.0171	.0129	.0042	.23	.0040	.0002	.59	1.1
1904,	.33	4.61	1.92	.0077	.0194	.0153	.0041	.23	.0047	.0002	.69	1.3
1905,	.40	4.30	1.95	.0112	.0202	.0160	.0042	.25	.0038	.0002	.71	1.1
1906,	.37	4.64	1.84	.0100	.0201	.0174	.0027	.26	.0032	.0002	.71	1.2
1907,	.38	4.60	1.88	.0079	.0194	.0135	.0059	.28	.0043	.0002	.62	1.2
1908,	.29	4.67	1.80	.0125	.0195	.0141	.0054	.36	.0048	.0003	.64	1.3
1909,	.31	5.16	2.38	.0185	.0213	.0161	.0052	.36	.0018	.0002	.68	1.5
1910,	.37	5.11	1.78	.0242	.0221	.0180	.0041	.35	.0035	.0007	.68	1.4
1911,	.39	5.32	2.09	.0166	.0219	.0165	.0054	.36	.0033	.0006	.65	1.5
1912,	.40	5.16	1.94	.0165	.0223	.0175	.0048	.32	.0013	.0003	.88	2.0
1913,[1]	.36	5.56	1.66	.0162	.0277	.0189	.0088	.39	.0030	.0003	.70	1.8
1914,	.30	5.32	1.74	.0170	.0255	.0181	.0074	.35	.0037	.0003	.61	1.6
1915,	.46	5.43	2.18	.0140	.0273	.0205	.0068	.32	–	–	.79	1.3
1916,[2]	.50	6.02	2.06	.0078	.0197	.0169	.0028	.25	–	–	.77	1.3
1917,	.34	6.58	2.12	.0117	.0222	.0166	.0056	.36	–	–	.54	1.4

[1] June omitted. [2] October omitted.

MERRIMACK RIVER.

Chemical Examination of Water from Merrimack River, etc. — *Concluded.*

Merrimack River, above Lawrence.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1887, ...	.47	4.82	1.24	.0027	.0211	–	–	.22	.0097	–	–	–
1888, ...	.32	3.64	1.13	.0029	.0197	.0153	.0044	.18	.0074	.0003	–	–
1889, ...	.35	–	–	.0047	.0212	.0176	.0036	.20	.0053	.0002	–	–
1890, ...	.37	4.27	1.56	.0061	.0187	.0148	.0039	.19	.0068	.0002	–	1.6
1891, ...	.21	4.06	1.37	.0066	.0179	.0138	.0041	.21	.0090	.0002	–	1.4
1892, ...	.46	4.25	1.50	.0054	.0186	.0155	.0031	.19	.0087	.0002	–	1.5
1893, ...	.40	4.25	1.62	.0084	.0172	.0138	.0034	.23	.0057	.0003	.52	1.3
1894, ...	.32	3.82	1.35	.0086	.0174	.0142	.0032	.25	.0043	.0001	.40	1.3
1895, ...	.52	4.45	1.97	.0068	.0251	.0194	.0057	.30	.0067	.0003	.60	1.5
1896, ...	.46	4.24	1.70	.0100	.0224	.0181	.0043	.25	.0067	.0005	.57	1.3
1897, ...	.58	4.06	1.67	.0061	.0222	.0190	.0032	.21	.0053	.0002	.53	1.0
1898, ...	.44	4.46	1.87	.0076	.0262	.0208	.0054	.25	.0050	.0005	.59	1.3
1899, ...	.24	4.42	1.57	.0138	.0277	.0207	.0070	.32	.0052	.0004	.43	1.3
1900, ...	.27	4.22	1.35	.0126	.0249	.0190	.0059	.32	.0050	.0003	.46	1.3
1901, ...	.44	4.73	1.90	.0100	.0280	.0205	.0075	.28	.0070	.0006	.65	1.5
1902, ...	.42	4.40	1.85	.0110	.0231	.0180	.0051	.26	.0038	.0003	.65	1.1
1903, ...	.37	4.66	1.73	.0111	.0226	.0166	.0060	.31	.0052	.0005	.64	1.4
1904, ...	.31	4.67	1.80	.0211	.0247	.0170	.0077	.33	.0053	.0004	.62	1.4
1905, ...	.44	4.92	2.01	.0177	.0242	.0183	.0059	.38	.0040	.0005	.74	1.2
1906, ...	.39	5.30	2.12	.0170	.0263	.0215	.0048	.40	.0027	.0005	.72	1.4
1907, ...	.40	4.92	1.80	.0293	.0253	.0175	.0078	.41	.0047	.0005	.59	1.3
1908, ...	.33	5.61	2.19	.0354	.0303	.0196	.0107	.57	.0052	.0006	.74	1.5
1909, ...	.33	6.28	2.04	.0336	.0262	.0196	.0066	.53	.0025	.0007	.67	1.7
1910, ...	.39	–	–	.0266	.0242	.0183	.0059	.53	.0125	.0008	.57	1.6
1911, ...	.23	8.25	3.10	.0240	.0286	.0227	.0059	.53	.0118	.0007	.65	1.6
1912, ...	.21	6.49	2.62	.0241	.0225	.0188	.0037	.52	.0151	.0006	.59	1.3
1913, ...	.25	7.46	2.93	.0245	.0224	.0185	.0039	.57	.0167	.0007	.61	1.5
1914, ...	.23	6.85	2.62	.0280	.0246	.0201	.0045	.59	.0190	.0003	.59	1.7
1915, ...	.33	7.05	2.83	.0183	.0230	.0177	.0053	.47	.0139	.0002	.69	1.6
1916, ...	.47	6.89	2.77	.0143	.0211	.0146	.0065	.43	.0175	.0004	.55	1.4
1917, ...	.44	6.54	2.53	.0147	.0203	.0169	.0034	.50	.0147	.0007	.47	1.2

Miller's River.

A general statement of the condition of this river in the year 1917 will be found on page 246.

MILLER'S RIVER.

Chemical Examination of Water from Miller's River. — Averages for Six Months, from June to November, inclusive.

Miller's River, below Miller's Falls.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1908,	.54	4.59	2.06	.0054	.0233	.0181	.0052	.34	.0060	.0002	.64	–
1909,	.54	4.38	1.84	.0035	.0207	.0181	.0026	.34	.0030	.0002	.60	–
1910,	.55	5.48	2.28	.0068	.0231	.0202	.0029	.44	.0075	.0002	.68	–
1911,	.66	5.98	2.58	.0056	.0258	.0220	.0038	.35	.0052	.0002	.90	–
1912,	.51	5.30	2.17	.0047	.0242	.0202	.0040	.42	.0060	.0002	.61	–
1913,	.59	5.65	1.88	.0056	.0315	.0231	.0084	.36	.0081	.0002	.69	–
1914,	.44	5.17	1.85	.0073	.0251	.0204	.0047	.36	.0068	.0003	.49	–
1915,	.88	5.77	2.75	.0092	.0311	.0256	.0055	.31	–	–	.93	–
1916,	.80	4.85	2.14	.0093	.0274	.0212	.0062	.31	–	–	.97	–
1917,	.75	5.90	2.75	.0058	.0281	.0224	.0057	.25	–	–	.78	–

Nashua River.

A general statement of the condition of this river in the year 1917 will be found on page 247.

NASHUA RIVER.

Chemical Examination of Water from Nashua River. — Averages for Six Months, from June to November, inclusive.

North Branch of Nashua River, below Fitchburg.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1893,	.70	8.32	2.38	.0562	.0405	.0289	.0116	.73	.0097	.0030	.73	2.2
1894,	.66	9.18	2.22	.0987	.0425	.0308	.0117	.99	.0123	.0034	.64	2.4
1895,	.71	9.42	2.72	.1387	.0493	.0381	.0112	1.08	.0088	.0014	.82	2.6
1896,	.57	9.27	2.62	.0898	.0537	.0384	.0153	.95	.0127	.0030	.71	2.4
1897,	.67	7.62	2.50	.0512	.0518	.0389	.0129	.71	.0112	.0009	.79	2.1
1898,	.56	7.02	2.37	.0688	.0629	.0399	.0230	.56	.0097	.0016	.72	1.8
1899,	.53	10.12	2.95	.1507	.0848	.0537	.0311	1.03	.0055	.0013	.83	2.4
1900,	.42	9.55	2.42	.1575	.0825	.0479	.0346	1.03	.0080	.0015	.73	2.6
1901,	.42	8.45	2.58	.0964	.0508	.0347	.0161	.67	.0080	.0013	.69	2.2
1902,	.39	7.83	2.42	.1070	.0557	.0407	.0150	.68	.0072	.0012	.71	1.9
1903,	.38	7.21	2.10	.1200	.0471	.0281	.0190	.73	.0095	.0014	.62	1.7
1904,	.33	9.05	2.70	.1858	.0596	.0341	.0255	.88	.0077	.0015	.70	2.1
1905,	.48	7.66	2.33	.1284	.0568	.0354	.0214	.73	.0053	.0008	.89	2.1
1906,	.47	7.68	2.16	.1037	.0558	.0356	.0202	.75	.0083	.0020	.68	2.0
1907,	.50	10.77	2.72	.2180	.0654	.0350	.0304	1.24	.0065	.0012	.72	2.8
1908,	.52	15.05	3.60	.2605	.0861	.0494	.0367	1.58	.0033	.0016	1.04	–
1909,	.52	15.85	3.42	.3220	.0958	.0563	.0395	1.87	.0027	.0014	1.02	–
1910,	.60	20.11	4.90	.4047	.1235	.0789	.0446	2.29	.0017	.0009	1.03	–
1911,	.51	19.38	5.57	.2848	.1035	.0566	.0469	2.37	.0027	.0015	1.15	–
1912,	.57	19.52	4.99	.2380	.1007	.0560	.0447	2.20	.0032	.0019	1.22	–
1913,	.40	23.45	4.97	.2770	.1064	.0561	.0503	2.02	.0028	.0013	1.42	5.0
1914,	.41	26.93	5.78	.3260	.1156	.0662	.0494	2.60	.0020	.0006	1.55	5.9
1915,[1]	.41	14.68	3.52	.0578	.0745	.0296	.0449	1.26	–	–	.94	3.1
1916,[2]	.42	18.52	5.12	.1043	.0778	.0380	.0398	2.12	–	–	1.03	3.2
1917,	.42	15.66	4.00	.0433	.0702	.0394	.0308	1.68	–	–	.74	–

[1] October omitted.

[2] August omitted.

NASHUA RIVER.

Chemical Examination of Water from Nashua River, etc. — *Concluded.*

North Branch of Nashua River, at Lancaster.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1892,	.48	9.75	2.10	.0422	.0274	.0237	.0037	1.11	.0450	.0010	–	3.0
1894,	.49	8.07	1.97	.0215	.0226	.0182	.0044	.97	.0295	.0011	.49	2.2
1895,	.51	8.28	2.39	.0318	.0272	.0214	.0058	1.01	.0284	.0034	.56	2.3
1896,	.57	6.97	2.17	.0253	.0322	.0253	.0069	.66	.0167	.0034	.60	2.0
1897,	.65	5.45	2.03	.0225	.0290	.0221	.0069	.40	.0153	.0015	.68	1.5
1898,	.48	6.33	2.10	.0409	.0345	.0263	.0082	.56	.0227	.0033	.51	1.7
1899,	.39	7.60	2.33	.0739	.0365	.0305	.0060	.75	.0153	.0028	.60	2.0
1900,	.29	7.17	1.55	.0545	.0326	.0264	.0062	.81	.0202	.0039	.52	2.1
1901,	.37	6.72	2.14	.0432	.0329	.0240	.0089	.54	.0087	.0021	.58	1.9
1902,	.40	7.96	2.66	.0757	.0324	.0267	.0057	.70	.0188	.0043	.58	1.8
1903,	.36	6.95	2.35	.0473	.0260	.0201	.0059	.58	.0258	.0034	.52	1.6
1904,	.32	8.01	2.18	.0803	.0318	.0267	.0051	.80	.0267	.0040	.53	2.0
1905,	.34	7.20	2.13	.0616	.0296	.0227	.0069	.70	.0207	.0044	.50	1.9
1906,	.44	7.34	2.12	.0519	.0311	.0240	.0071	.72	.0238	.0027	.56	2.0
1907,	.44	8.34	2.33	.0600	.0294	.0232	.0062	.89	.0333	.0084	.53	2.1
1908,	.40	10.69	2.73	.1075	.0309	.0259	.0050	1.28	.0405	.0090	.58	–
1909,	.44	12.26	3.41	.1556	.0330	.0284	.0046	1.46	.0360	.0066	.60	–
1910,	.45	13.44	3.82	.1655	.0462	.0366	.0096	1.63	.0388	.0108	.70	–
1911,	.51	15.64	4.10	.3067	.0828	.0408	.0420	1.95	.0208	.0083	.92	–
1912,	.45	12.65	3.10	.1252	.0438	.0275	.0163	1.68	.0343	.0083	.72	–
1913,	.43	15.45	3.02	.2292	.0533	.0386	.0147	1.75	.0133	.0053	.80	4.2
1914,	.39	16.80	3.15	.2147	.0466	.0336	.0130	1.94	.0262	.0115	.67	4.1
1915,	.42	12.10	3.49	.0757	.0465	.0294	.0171	1.31	–	–	.68	2.4
1916,[1]	.41	12.34	3.92	.0539	.0336	.0257	.0079	1.28	–	–	.73	2.7
1917,	.32	14.28	2.82	.0542	.0343	.0240	.0103	1.52	–	–	.51	–

[1] October omitted.

Nashua River, at Pepperell.

1899,	.28	6.91	2.19	.0167	.0248	.0221	.0027	.78	.0137	.0008	.46	2.1
1901,	.37	6.00	2.06	.0154	.0266	.0230	.0036	.45	.0092	.0005	.55	1.9
1902,	.37	5.81	2.07	.0118	.0184	.0167	.0017	.49	.0162	.0006	.51	1.7
1903,	.35	5.15	1.57	.0097	.0180	.0152	.0028	.44	.0128	.0008	.55	1.6
1904,[1]	.30	6.23	1.93	.0111	.0206	.0171	.0035	.58	.0243	.0008	.44	1.9
1908,	.32	10.85	3.40	.0317	.0295	.0202	.0093	1.45	.0194	.0008	.63	–
1909,	.38	14.29	4.62	.0354	.0376	.0291	.0085	1.95	.0211	.0017	.92	–
1910,	.37	14.77	4.14	.0128	.0329	.0252	.0077	1.93	.0207	.0008	.81	–
1911,	.40	12.10	3.77	.0423	.0393	.0293	.0100	1.31	.0213	.0048	.62	–
1912,[2]	.48	12.52	3.28	.0223	.0409	.0254	.0155	1.46	.0204	.0017	.75	–
1913,[3]	.43	11.99	2.79	.0515	.0405	.0276	.0129	1.15	.0164	.0019	.73	–
1914,[4]	.31	12.67	2.75	.0595	.0459	.0286	.0173	1.27	.0132	.0027	.59	–
1915,	.46	8.25	2.27	.0222	.0328	.0237	.0091	.85	–	–	.63	–
1916,[1]	.43	8.57	2.33	.0191	.0248	.0197	.0051	.78	–	–	.57	–
1917,	.39	10.96	4.06	.0434	.0357	.0204	.0153	1.25	–	–	.54	–

[1] Three months. [2] November omitted. [3] Four months. [4] Two months.

Neponset River.

A general statement of the condition of this river in the year 1917 will be found on page 247.

NEPONSET RIVER.

Chemical Examination of Water from Neponset River. — Averages for Six Months, from June to November, inclusive.

Neponset River, at Hyde Park.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.	Albuminoid.			Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1887, . . .	1.18	8.20	2.22	.0053	.0402	–	–	.98	.0077	–	–	–
1888, . . .	1.12	7.77	2.37	.0040	.0392	.0358	.0034	1.08	.0074	.0003	–	–
1893, . . .	1.27	8.60	2.68	.0233	.0370	.0282	.0088	1.47	.0045	.0009	1.00	2.6
1894, . . .	1.19	12.87	3.03	.0196	.0466	.0333	.0133	2.31	.0033	.0002	1.03	4.1
1895, . . .	.97	10.01	3.07	.0341	.0440	.0373	.0067	1.51	.0042	.0001	1.05	3.7
1896, . . .	1.26	10.41	3.12	.0162	.0431	.0395	.0036	1.68	.0033	.0001	1.26	3.3
1897, . . .	1.30	11.64	3.34	.0336	.0494	.0417	.0077	1.81	.0037	.0001	1.31	4.0
1898, . . .	1.28	8.82	3.52	.0161	.0505	.0398	.0107	1.02	.0023	.0002	1.30	2.7
1899, . . .	1.14	16.24	4.51	.0264	.0936	.0693	.0243	2.20	.0032	.0002	1.76	5.7
1900, . . .	1.10	10.59	2.99	.0400	.0576	.0381	.0195	1.45	.0048	.0005	1.07	3.2
1901, . . .	1.43	13.26	5.09	.0224	.0802	.0591	.0211	1.69	.0036	.0006	1.82	4.2
1902, . . .	1.02	12.57	4.19	.0360	.0640	.0547	.0093	1.72	.0035	.0004	1.29	4.0
1903, . . .	1.29	14.21	4.95	.0278	.0811	.0638	.0173	1.86	.0034	.0010	1.71	4.5
1904, . . .	1.08	16.22	5.68	.0631	.1007	.0777	.0230	2.07	.0037	.0005	1.67	5.6
1905, . . .	1.22	21.88	6.68	.0813	.1043	.0861	.0182	3.44	.0028	.0006	2.22	6.6
1906, . . .	1.35	13.47	4.42	.0549	.0875	.0674	.0201	2.21	.0025	.0008	1.85	3.9
1907, . . .	.90	22.58	6.31	.1201	.1412	.0961	.0451	3.81	.0042	.0004	1.94	6.9
1908, . . .	–	25.40	7.19	.1132	.1209	.0844	.0365	5.08	.0027	.0006	2.01	8.8
1909, . . .	–	28.69	9.08	.1723	.1218	.0898	.0320	5.35	.0027	.0009	2.02	10.0
1910, . . .	–	31.37	10.16	.1740	.1333	.1000	.0333	5.84	.0010	.0002	2.96	10.4
1911, . . .	1.24	18.82	5.49	.0786	.0727	.0539	.0188	3.36	.0025	.0007	1.86	7.1
1912, . . .	.82	26.02	6.45	.1241	.1020	.0707	.0313	4.18	.0017	.0012	2.31	9.2
1913, . . .	1.02	26.13	6.22	.0533	.0757	.0494	.0263	3.93	.0020	.0007	2.29	7.9
1914, . . .	.93	20.27	4.37	.0754	.0697	.0484	.0213	3.43	.0025	.0008	1.31	5.2
1915,[1] . . .	1.23	19.67	6.30	.0530	.1078	.0649	.0429	2.42	–	–	1.92	5.3
1916, . . .	1.28	19.47	5.37	.0466	.0761	.0554	.0207	2.37	–	–	1.96	–
1917, . . .	.93	15.55	6.40	.0474	.0599	.0394	.0205	1.88	–	–	1.09	–

[1] Four months.

Quinebaug River.

A general statement of the condition of this river in the year 1917 will be found on page 247.

QUINEBAUG RIVER.

Chemical Examination of Water from Quinebaug River. — Averages for Six Months, from June to November, inclusive.

Quinebaug River, below Southbridge.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898,	.64	4.18	2.00	.0064	.0372	.0309	.0063	.18	.0050	.0003	.66	0.8
1899,	.44	4.32	1.72	.0071	.0298	.0229	.0069	.23	.0048	.0002	.54	1.2
1900,	.40	4.31	1.56	.0168	.0324	.0211	.0113	.25	.0024	.0003	.52	1.0
1901,	.42	4.52	1.67	.0147	.0232	.0158	.0074	.19	.0050	.0005	.45	1.7
1902,	.36	4.12	1.45	.0068	.0224	.0179	.0045	.24	.0054	.0002	.43	1.2
1903,[1]	.39	3.84	1.37	.0076	.0225	.0181	.0044	.24	.0043	.0002	.52	1.0
1904,	.40	4.17	1.57	.0086	.0247	.0189	.0058	.26	.0068	.0002	.53	1.2
1908,	.46	6.82	2.31	.0075	.0277	.0174	.0103	.33	.0038	.0003	.57	–
1909,	.40	5.48	1.99	.0087	.0275	.0219	.0056	.37	.0077	.0003	.56	–
1910,	.40	6.20	2.27	.0104	.0334	.0246	.0088	.42	.0032	.0004	.53	–
1911,[1]	.50	5.92	2.09	.0180	.0308	.0240	.0068	.41	.0067	.0002	.66	–
1912,[2]	.41	7.35	2.40	.0152	.0397	.0272	.0125	.52	.0025	.0004	.59	–
1913,[1]	.39	6.08	1.88	.0201	.0283	.0219	.0064	.59	.0075	.0007	.53	–
1914,	.52	11.93	2.36	.3033	.0514	.0323	.0191	2.41	.0078	.0052	.47	–
1915,	.68	7.56	2.49	.1499	.0457	.0327	.0130	.82	–	–	.91	–
1916,	.54	8.12	3.32	.0867	.0367	.0266	.0101	.52	–	–	.76	–
1917,	.42	5.32	1.65	.0380	.0297	.0201	.0096	.35	–	–	.47	–

[1] Four months. [2] Two months.

TAUNTON RIVER.

A general statement of the condition of this river in the year 1917 will be found on page 248.

TAUNTON RIVER.

CHEMICAL EXAMINATION OF WATER FROM TAUNTON RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Taunton River, below Taunton.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898,	1.56	6.64	3.30	.0109	.0345	.0314	.0031	.61	.0082	.0003	1.51	1.3
1899,	.93	6.31	2.48	.0176	.0317	.0279	.0038	.72	.0060	.0004	1.04	1.2
1900,	.71	6.89	1.91	.0205	.0286	.0258	.0028	1.06	.0112	.0006	.76	1.5
1901,	1.01	6.15	2.45	.0293	.0275	.0255	.0020	.76	.0134	.0005	.92	1.6
1902,[1]	.94	6.92	2.36	.1902	.0363	.0308	.0055	1.29	.0116	.0012	.90	1.4
1903,	.96	7.06	2.60	.0542	.0270	.0234	.0036	1.10	.0177	.0013	1.02	1.7
1904,	.95	6.49	2.60	.0855	.0319	.0264	.0055	.94	.0137	.0008	1.06	1.3
1906,[2]	1.41	7.37	3.11	.0401	.0385	.0331	.0054	.95	.0162	.0008	1.36	1.4
1907,[3]	.94	7.16	2.62	.1031	.0343	.0282	.0061	1.05	.0115	.0009	1.05	1.7
1908,	.73	7.66	2.52	.0469	.0278	.0226	.0052	1.31	.0108	.0011	.74	–
1909,	.90	12.97	3.87	.0416	.0303	.0263	.0040	3.49	.0105	.0014	.88	–
1910,	1.04	19.62	5.69	.0658	.0376	.0305	.0071	6.82	.0110	.0027	.93	–
1911,	1.04	9.65	2.80	.0385	.0330	.0270	.0060	1.73	.0205	.0015	1.04	–
1912,	1.17	10.35	2.95	.0461	.0366	.0295	.0071	1.76	.0173	.0015	1.03	–
1913,	1.09	18.58	4.24	.0506	.0377	.0334	.0043	5.94	.0130	.0015	1.07	–
1914,	.92	18.10	3.33	.0701	.0389	.0323	.0066	5.95	.0100	.0020	.88	–
1915,	1.35	9.38	3.38	.0469	.0465	.0374	.0091	1.24	–	–	1.34	–
1916,	1.70	9.58	3.72	.0323	.0424	.0341	.0083	1.20	–	–	1.74	–
1917,	1.36	9.05	3.98	.0345	.0423	.0336	.0087	1.31	–	–	1.30	–

[1] September omitted. [2] June omitted. [3] Four months.

Ten Mile River.

A general statement of the condition of this river in the year 1917 will be found on page 248.

TEN MILE RIVER.

Chemical Examination of Water from Ten Mile River. — Averages for Six Months, from June to November, inclusive.

Ten Mile River, below Attleboro.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899,	.71	6.39	2.15	.0072	.0379	.0288	.0091	.62	.0133	.0004	.74	1.7
1900,	.47	6.19	1.60	.0125	.0363	.0241	.0122	.84	.0155	.0004	.49	1.8
1901,	.46	6.09	2.12	.0084	.0290	.0202	.0088	.71	.0222	.0004	.51	1.8
1902,	.41	6.49	1.83	.0073	.0394	.0237	.0157	.88	.0212	.0004	.52	1.9
1903,	.36	7.48	2.39	.0282	.0346	.0200	.0146	.84	.0315	.0020	.53	1.8
1904,	.44	8.89	2.97	.0931	.0527	.0332	.0195	1.03	.0532	.0033	.58	3.5
1906,[1]	.48	17.57	6.45	.1586	.0914	.0490	.0424	1.07	.0638	.0121	.92	7.9
1907,[1]	.42	19.07	6.14	.6036	.1471	.0830	.0641	1.73	.2014	.0100	1.18	7.5
1908,	.40	10.89	3.27	.1108	.0483	.0294	.0189	1.37	.0364	.0035	.61	–
1909,	.47	11.23	2.88	.4322	.0626	.0380	.0246	1.51	.0263	.0086	.78	–
1910,	.29	12.05	3.32	.2422	.0545	.0330	.0215	1.98	.0357	.0051	.48	–
1911,	.76	11.94	3.58	.0604	.0506	.0302	.0204	1.55	.0382	.0036	.94	–
1912,	.39	28.98	11.42	.1056	.0750	.0287	.0463	1.92	.0368	.0075	.75	3.6
1913,	.64	13.55	3.33	.0951	.0630	.0303	.0327	1.90	.0242	.0069	.84	–
1914,	.51	15.32	3.09	.1909	.0673	.0401	.0272	1.73	.0300	.0087	.77	–
1915,[1]	.88	11.10	3.30	.0954	.0494	.0346	.0148	1.37	–	–	.98	3.2
1916,	–	13.23	3.42	.0912	.0510	.0340	.0170	1.66	–	–	.91	3.0
1917,[2]	.72	10.62	3.72	.0613	.0349	.0250	.0099	1.08	–	–	.66	–

[1] June omitted. [2] November omitted.

Westfield River.

A general statement of the condition of this river in the year 1917 will be found on page 248.

WESTFIELD RIVER.

Chemical Examination of Water from Westfield River. — Averages for Six Months, from June to November, inclusive.

Westfield River, below Westfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as —		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1902,	.22	4.21	1.60	.0062	.0144	.0118	.0026	.14	.0062	.0002	.39	1.9
1903,	.15	3.68	1.30	.0037	.0127	.0105	.0022	.16	.0088	.0003	.28	1.8
1904,	.21	4.16	1.59	.0067	.0152	.0119	.0033	.16	.0068	.0001	.38	1.9
1906,[1]	.21	4.65	1.48	.0086	.0161	.0135	.0026	.18	.0035	.0003	.29	2.1
1907,	.24	4.49	1.63	.0053	.0137	.0111	.0026	.21	.0075	.0003	.31	2.0
1908,	.17	5.27	2.19	.0218	.0161	.0116	.0045	.27	.0063	.0006	.28	–
1909,	.22	5.56	1.68	.0179	.0187	.0143	.0044	.26	.0075	.0005	.34	–
1910,	.13	6.71	2.39	.0214	.0143	.0120	.0023	.30	.0304	.0010	.21	–
1911,	.25	5.86	2.03	.0272	.0162	.0133	.0029	.28	.0077	.0008	.38	–
1912,[2]	.13	6.40	2.08	.0286	.0189	.0130	.0059	.34	.0204	.0014	.24	–
1913,	.23	6.75	1.78	.0247	.0215	.0147	.0068	.30	.0292	.0012	.36	–
1914,	.15	6.50	1.72	.0255	.0255	.0161	.0094	.33	.0101	.0013	.26	–
1915,	.23	5.70	1.78	.0191	.0224	.0159	.0065	.27	–	–	.38	–
1916,	.25	6.58	2.62	.0258	.0183	.0139	.0044	.26	–	–	.39	–
1917,	.15	6.04	2.20	.0379	.0193	.0154	.0039	.31	–	–	.28	–

[1] Four months.

[2] September omitted.

Examination of Sewage Disposal Works.

The average results of analyses of sewage and effluent, and statistics concerning the more important sewage disposal works in the State, are presented in the following tables.

Very few changes of any kind have been made in the sewage disposal works of the State during the year 1917, for reasons connected with the war. A number of works are now overtaxed and additional means of purification are greatly needed, but the difficulty of getting labor and materials, and the enormous cost of such works, has prevented the carrying out of many of these undertakings.

The construction of additional filters has been begun at Andover and Stockbridge, but these filters are not yet completed. The works which are most in need of additions and improvements are those at Brockton, Clinton, Milford, Natick, Northbridge, Norwood and Southbridge. The works at Fitchburg do not treat all of the sewage of the city at the present time and these works will require enlargement as soon as it is practicable to do such work. The works at Worcester are wholly inadequate for the proper treatment of the sewage, and experiments upon the possibility of the use of the activated sludge method of treatment of the sewage of the city were begun during the past year.

The following tables, which are made up in much the same way as in previous years, contain the results of chemical analyses of sewage and effluent from the more important sewage disposal works, together with general information as to the design, construction and maintenance of the works: —

TABLE No. 1. — *Average Results of the Analyses of Monthly Samples of Sewage as Received at the Disposal Works, 1917 (Fats determined in about 70 Per Cent. of the Samples).*

[Parts in 100,000.]

City or Town.	Residue on Evaporation. Total Residue. Total.	Residue on Evaporation. Total Residue. Dissolved.	Residue on Evaporation. Total Residue. Suspended.	Residue on Evaporation. Loss on Ignition. Total.	Residue on Evaporation. Loss on Ignition. Dissolved.	Residue on Evaporation. Loss on Ignition. Suspended.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Oxygen Consumed. Unfiltered.	Oxygen Consumed. Filtered.	Iron. Unfiltered.	Iron. Filtered.	Kjeldahl Nitrogen.	Fats.
Andover,	57.93	42.44	15.49	30.05	17.33	12.72	3.01	.76	.48	.28	8.29	6.66	4.99	.159	.069	1.26	7.01
ATTLEBORO,[1]	53.11	36.08	17.03	25.34	11.54	13.80	3.88	.86	.57	.29	8.28	4.73	2.43	.216	.079	1.53	–
BROCKTON,	129.08	53.90	75.18	89.97	22.47	67.50	4.94	2.10	.89	1.21	11.16	19.96	9.17	.657	.098	4.37	13.85
Clinton,	154.71	77.70	77.01	100.03	36.00	64.03	4.24	1.80	.89	.91	6.54	20.75	9.98	.892	.297	3.48	42.46
Concord,[2]	33.87	25.47	8.40	17.97	11.30	6.67	2.07	.58	.35	.23	4.16	3.70	2.58	–	–	1.02	–
FITCHBURG,	50.46	32.53	17.93	22.58	12.63	9.95	2.28	.68	.45	.23	6.00	6.28	3.74	–	–	1.42	5.03
Framingham,	125.56	76.82	48.74	63.99	26.05	37.94	5.17	1.93	1.14	.79	19.91	13.13	7.16	.356	.087	3.54	12.43
Franklin,[2]	37.26	24.00	13.26	18.30	8.50	9.80	2.61	.81	.46	.35	3.51	3.55	1.57	–	–	1.46	–
Gardner[3] (Gardner area),	194.80	53.80	141.00	155.10	31.75	123.35	4.68	3.22	1.49	1.73	6.03	35.15	8.85	.225	.054	7.81	14.66
Gardner (Templeton area),	111.53	49.83	61.70	76.65	23.70	52.95	6.01	2.01	.94	1.07	9.22	12.20	5.21	.229	.047	3.39	10.87
Hopedale,[2]	71.74	50.68	21.06	39.06	20.51	18.55	7.74	1.27	.76	.51	10.85	8.24	4.49	–	–	2.31	5.37
Hudson,	160.07	122.72	37.35	64.92	40.00	24.92	6.21	2.89	1.98	.91	39.66	14.37	8.17	.307	.051	5.07	5.32
Leicester,[4]	48.35	33.35	15.00	27.30	15.45	11.85	2.99	.77	.42	.35	4.85	6.85	3.52	.245	.058	2.28	–
Marion,[5]	33.92	25.90	8.02	17.02	11.15	5.87	1.74	.51	.28	.23	4.37	3.00	2.14	.132	.047	1.11	–
MARLBOROUGH,	71.83	51.51	20.32	35.23	19.40	15.83	4.99	1.33	.70	.63	12.30	8.37	4.62	.208	.082	2.00	9.60
Milford,	69.00	49.25	19.75	34.73	20.00	14.73	4.59	1.06	.66	.40	8.85	8.08	4.32	.159	.044	1.93	5.43
Natick,	52.29	41.87	10.42	21.13	12.92	8.21	3.59	.66	.41	.25	9.23	5.08	3.31	.175	.058	1.13	5.44
North Attleborough,[2]	39.93	25.80	14.13	18.47	8.13	10.34	1.14	.52	.38	.14	5.68	3.66	2.15	.138	.058	1.10	–
Northbridge,[1]	39.37	28.26	11.11	22.94	15.40	7.54	3.86	1.06	.67	.39	4.28	5.54	2.64	–	–	2.12	–
Norwood,	95.49	78.44	17.05	33.84	19.51	14.33	2.54	.72	.35	.37	25.72	9.27	6.32	.202	.074	1.51	5.92
PITTSFIELD,	43.56	34.16	9.40	21.68	14.18	7.50	2.48	.66	.38	.28	4.74	4.24	2.70	.149	.058	1.30	4.59
Southbridge,[1]	56.23	41.57	14.66	31.94	19.83	12.11	3.72	1.05	.67	.38	7.54	7.51	4.93	.182	.065	2.25	–
Spencer,[1]	36.60	26.63	9.97	18.83	11.34	7.49	3.09	.76	.45	.31	4.47	5.21	3.06	.138	.054	1.35	3.32
Stockbridge,[5]	26.86	24.56	2.30	10.22	8.56	1.66	.98	.25	.15	.10	1.72	1.44	1.20	–	–	.45	–
Westborough,	45.80	35.11	10.69	24.23	15.29	8.94	2.72	.77	.51	.26	5.93	6.26	4.24	.151	.050	1.68	4.76
WORCESTER (day),[6]	117.80	84.24	33.56	48.64	23.48	25.16	2.98	1.29	.54	.75	12.46	12.16	7.16	5.540	1.368	2.48	–
WORCESTER (night),[7]	125.67	85.33	40.34	53.10	24.06	29.04	2.00	.84	.32	.52	8.79	11.23	5.39	12.250	6.767	2.34	–

[1] Seven samples.
[2] Samples every other month.
[3] Four samples. Not representative samples.
[4] Four samples.
[5] Eight samples.
[6] Five samples.
[7] Six samples.

TABLE No. 2. — *Average Results of Analyses of Monthly Samples of Sewage as applied to Filter Beds after Preliminary Treatment as indicated (Fats determined in about 70 Per Cent. of the Samples).*

[Parts in 100,000.]

City or Town.	Form of Preliminary Treatment.	Residue on Evaporation.						Ammonia.				Chlorine.	Oxygen Consumed.		Iron.		Kjeldahl Nitrogen.	Fats.
		Total Residue.			Loss on Ignition.				Albuminoid.									
		Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.		Unfiltered.	Filtered.	Unfiltered.	Filtered.		
Andover,	Tank,	45.26	38.29	6.97	20.18	14.61	5.57	3.21	.61	.43	.18	7.96	5.89	4.57	.138	.067	1.13	4.19
ATTLEBORO,[1]	None.	53.11	36.08	17.03	25.34	11.54	13.80	3.88	.86	.57	.29	8.28	4.73	2.43	.216	.079	1.53	–
BROCKTON,	Revolving screen,	78.62	55.93	22.69	41.90	22.80	19.10	5.22	1.35	.72	.63	11.45	11.85	7.14	.308	.095	2.38	8.60
Clinton,	Basins,	68.63	58.55	10.08	32.40	25.28	7.12	3.37	.85	.56	.29	5.56	7.58	5.75	1.147	.715	1.57	9.81
Concord,[2]	None,	33.87	25.47	8.40	17.97	11.30	6.67	2.07	.58	.35	.23	4.16	3.70	2.58	–	–	1.02	–
FITCHBURG,	Imhoff tanks,	40.25	35.82	4.43	17.99	15.43	2.56	2.28	.49	.38	.11	5.89	4.63	3.40	–	–	1.10	3.56
Framingham,	None,	125.56	76.82	48.74	63.99	26.05	37.94	5.17	1.93	1.14	.79	19.91	13.13	7.16	.356	.087	3.54	12.43
Franklin,[2]	Tanks,	22.98	20.69	2.29	7.84	6.10	1.74	1.66	.31	.21	.10	3.39	1.44	1.01	–	–	.67	–
Gardner[3] (Gardner area),	None,	194.80	53.80	141.00	155.10	31.75	123.35	4.68	3.22	1.49	1.73	6.03	35.15	8.85	.225	.054	7.81	14.66
Gardner (Templeton area),	Tanks,	41.38	34.35	7.03	18.57	13.42	5.15	4.18	.75	.48	.27	6.17	4.16	2.68	.166	.057	1.40	3.88
Hopedale,[2]	Tanks,	34.86	29.00	5.86	16.49	11.97	4.52	4.44	.73	.45	.28	4.99	3.58	2.82	–	–	1.12	3.33
Hudson,	Tanks,	93.41	76.96	16.45	33.73	19.96	13.77	5.73	1.33	.94	.39	21.22	6.54	4.84	.152	.037	2.30	4.83
Leicester,[4]	Tanks,	36.20	27.12	9.08	14.88	8.52	6.36	2.28	.49	.31	.18	4.47	3.70	2.75	.520	.048	1.17	–
Marion,[5]	None,	33.92	25.90	8.02	17.02	11.15	5.87	1.74	.51	.28	.23	4.37	3.00	2.14	.132	.047	1.11	–
MARLBOROUGH,	Tanks,	56.98	48.43	8.55	24.36	17.48	6.88	5.10	.99	.58	.41	10.11	5.84	4.29	.273	.084	1.52	5.54
Milford,	Tanks,	49.70	39.57	10.13	21.42	13.00	8.42	4.10	.63	.45	.18	7.73	4.62	3.20	.172	.069	1.09	3.93
Natick,	None,	52.29	41.87	10.42	21.13	12.92	8.21	3.59	.66	.41	.25	9.23	5.08	3.31	.175	.058	1.13	5.44
North Attleborough,[2]	Tanks,	25.36	23.52	1.84	8.48	7.28	1.20	1.24	.26	.20	.06	5.33	1.57	1.22	.094	.047	.52	–
Northbridge,[1]	Tanks,	18.60	15.89	2.71	8.31	6.69	1.62	1.88	.33	.21	.12	2.60	1.80	1.18	–	–	.55	–
Norwood,	Tank,	80.93	69.80	11.13	25.03	16.40	8.63	3.01	.66	.37	.29	23.73	7.49	5.13	.171	.076	1.44	4.98
PITTSFIELD,	None,	43.56	34.16	9.40	21.68	14.18	7.50	2.48	.66	.38	.28	4.74	4.24	2.70	.149	.058	1.30	4.59
Southbridge,[1]	Tanks,	39.26	30.69	8.57	20.06	13.69	6.37	3.89	.66	.43	.23	6.01	4.47	2.99	.161	.087	1.36	–
Spencer,[1]	None,	36.60	26.63	9.97	18.83	11.34	7.49	3.09	.76	.45	.31	4.47	5.21	3.06	.138	.054	1.35	3.32
Stockbridge,[4]	None,	26.86	24.56	2.30	10.22	8.56	1.66	.98	.25	.15	.10	1.72	1.44	1.20	–	–	.45	–
Westborough,	None,	45.80	35.11	10.69	24.23	15.29	8.94	2.72	.77	.51	.26	5.93	6.26	4.24	.151	.050	1.68	4.76
WORCESTER (day),[4]	Tanks,	117.80	84.24	33.56	48.64	23.48	25.16	2.98	1.29	.54	.75	12.46	12.16	7.16	5.540	1.368	2.48	–

[1] Seven samples.
[2] Samples every other month.
[3] Four samples. Not representative samples.
[4] Five samples.
[5] Eight samples.

TABLE No. 3. — *Efficiency of Settling Tanks and Other Forms of Preliminary Treatment as indicated by the Foregoing Tables.*

[Parts in 100,000.]

City or Town.	Form of Preliminary Treatment.	Suspended Solids.			Total Albuminoid Ammonia.			Oxygen consumed.			Fats.[1]			Chlorine.		Approximate Period of Sedimentation, assuming Tanks contain no Deposits (Hours).
		Crude Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Crude Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Crude Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Crude Sewage.	Settled or Treated Sewage.	Per Cent. removed.	Crude Sewage.	Settled or Treated Sewage.	
Andover,	Tank,	15.49	6.97	55	.76	.61	20	6.66	5.89	12	7.01	4.19	40	8.29	7.96	¾–2½
BROCKTON,	Revolving screen,	75.18	22.69	70	2.10	1.35	36	19.96	11.85	41	13.85	8.60	38	11.16	11.45	–
Clinton,	Basins,	77.01	10.08	87	1.80	.85	53	20.75	7.58	63	42.46	9.81	77	6.54	5.56	2½–4½
FITCHBURG,	Imhoff tanks,[2]	17.93	4.43	75	.68	.49	28	6.28	4.63	26	5.03	3.56	29	6.00	5.89	7¼–8½
Franklin,	Tanks,	13.26	2.29	83	.81	.31	62	3.55	1.44	59	–	–	–	3.51	3.39	5¼–6
Gardner (Templeton area),	Tanks,	61.70	7.03	89	2.01	.75	63	12.20	4.16	66	10.87	3.88	64	9.22	6.17	5½–7¼
Hopedale,	Tanks,	21.06	5.86	72	1.27	.73	43	8.24	3.58	57	5.37	3.33	38	10.85	4.99	20–40
Hudson,	Tanks,	37.35	16.45	56	2.89	1.33	54	14.37	6.54	54	5.32	4.83	9	39.66	21.22	14½–28
Leicester,	Tanks,	15.00	9,08	39	.77	.49	36	6.85	3.70	46	–	–	–	4.85	4.47	–
MARLBOROUGH,	Tanks,	20.32	8.55	58	1.33	.99	26	8.37	5.84	30	9.60	5.54	42	12.30	10.11	–[3]
Milford,	Tanks,	19.75	10.13	49	1.06	.63	41	8,08	4.26	47	5.43	3.93	28	8.85	7.73	3¼–4¾
North Attleborough,	Tanks,	14.13	1.84	87	.52	.26	50	3.66	1.57	57	–	–	–	5.68	5.33	2¾–3¾
Northbridge,	Tanks,	11.11	2.71	76	1.06	.33	69	5.54	1.80	68	–	–	–	4.28	2.60	¾–1¾
Norwood,	Tank,	17.05	11.13	35	.72	.66	8	9.27	7.49	19	5.92	4.98	16	25.72	23.73	1¼–2½
Southbridge,	Tanks,	14.66	8.57	42	1.05	.66	37	7.51	4.47	40	–	–	–	7.54	6.01	2–8
WORCESTER,	Chemical precipitation,	40.34	12.30	70	.84	.43	49	11.23	4.81	57	–	–	–	8.79	8.97	5–6

[1] Fats determined in about 70 per cent. of the samples.

[2] Five tanks. Flow reversed six times a year.

[3] Several compartments to tank. Operated so as to get good sedimentation, but not to produce a septic effluent.

NOTE. — For number of samples, see footnotes to Tables No. 1 and No. 2.

TABLE No. 4. — *Average Results of the Analyses of Monthly Samples of Sewage applied to the Trickling Filters at Brockton and Fitchburg, and of their Effluents, etc. Per Cents. removed, etc.*

Brockton. [1]

[Parts in 100,000.]

	Residue on Evaporation.						Ammonia.					Nitrogen as —		Oxygen consumed.				
	Total Residue.			Loss on Ignition.				Albuminoid.										
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Unfiltered.	Filtered.	Kjeldahl Nitrogen.	Fats.	Remarks.
Screened sewage as applied to trickling filter.	65.78	44.49	21.29	33.76	17.07	16.69	5.68	1.34	.66	.68	9.97	-	-	8.13	5.26	6.28	2.37	The trickling filter has an area of .5 of an acre and a depth of 5.5 to 6.5 feet of crushed stone from 1½ to 3 inches in size. The average rate of operation was 1,286,000 gallons per acre per day.
Effluent from trickling filter,	53.71	41.93	11.78	22.89	15.93	6.96	3.40	.81	.43	.38	9.38	1.1488	.0503	5.15	2.66	2.54	1.53	
Per cent. removed, . .	18	-	45	32	-	58	40	40	-	44	-	-	-	37	49	60	35	
Settled effluent from trickling filter as applied to sand filters.	41.97	39.00	2.97	15.87	14.77	1.10	2.93	.57	.41	.16	8.63	.6386	.0287	3.77	2.60	3.44	1.12	
Per cent. removed, . .	22	-	75	31	-	84	14	30	-	58	-	-	-	27	22	-	27	
Per cent. removed by trickling filter and settling tank.	36	-	86	53	-	93	48	57	-	77	-	-	-	54	51	45	53	

Fitchburg. [2]

Imhoff tank effluent as applied to trickling filter.	40.25	35.82	4.43	17.99	15.43	2.56	2.28	.49	.38	.11	5.89	–	–	4.63	3.40	3.56	1.10	The trickling filter has an area of 2.14 acres and a depth of 10 feet of crushed stone from 1 to 3 inches in size. The average rate of operation was about 1,460,000 gallons per acre per day.
Effluent from trickling filter,	36.36	30.79	5.57	14.65	11.33	3.32	.75	.26	.16	.10	5.82	1.3088	.0131	2.05	1.39	2.13	.53	
Per cent. removed, . .	10	–	–	19	–	–	67	47	–	9	–	–	–	56	59	40	52	
Settled effluent from trickling filter as discharged to Nashua River.	34.25	31.57	2.68	12.48	11.03	1.45	.72	.21	.13	.08	5.98	1.1485	.0154	1.72	1.33	1.89	–	
Per cent. removed, . .	58	–	51	15	–	56	4	19	–	20	–	–	–	16	43	11	–	
Per cent. removed by trickling filter and settling tanks.	15	–	39	31	–	43	68	57	–	27	–	–	–	63	61	47	–	

[1] December, May and September omitted.

[2] August omitted.

TABLE No. 5. — *Average Results of the Analyses of Monthly Samples of Effluent from Sand Filters.*

[Parts in 100,000.]

City or Town.	Free Ammonia.	Total Albuminoid Ammonia.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Iron.
Andover,[1]	1.64	.1745	7.62	.6049	.0298	.303
BROCKTON[1] (sand filters used for screened sewage).	3.87	.1909	10.62	.1792	.0045	1.532
BROCKTON[2] (sand filters used for settled trickling filter effluent).	2.64	.1098	10.62	.2446	.0026	.753
Clinton,[3]	1.73	.1260	5.47	.2148	.0108	1.973
Concord,[4]	.44	.0370	4.17	.2393	.0011	.024
Framingham,[3]	1.98	.1393	11.98	.6300	.0204	1.829
Franklin,[4]	.53	.0363	3.35	.5240	.0044	.020
Gardner (Gardner area),[5]	2.27	.2910	7.10	1.2960	.0134	.097
Gardner (Templeton area),[1]	2.07	.2355	7.09	1.0250	.0247	.089
Hopedale,[4]	1.42	.1355	4.73	1.9914	.0261	.062
Hudson,	1.40	.1570	20.23	2.0381	.0453	.257
Leicester,[6]	.90	.0920	2.92	.6995	.0240	.163
Marion,[7]	.29	.0589	3.84	.7577	.0044	.046
MARLBOROUGH,[1]	.93	.0941	8.12	1.7619	.0102	.051
Milford,	1.55	.1208	7.16	.8943	.0162	.494
Natick,	2.14	.1193	8.23	.2884	.0055	1.045
North Attleborough,[4]	.03	.0123	3.42	.7658	.0008	.006
Northbridge,[8]	1.05	.1045	3.41	.3056	.0112	.880
Norwood,	1.18	.0959	17.23	.3589	.0190	.719
PITTSFIELD,[1]	.87	.1134	4.10	.6096	.0132	.352
Southbridge,[1]	2.46	.1195	5.64	.0650	.0028	1.977
Spencer,[9]	.24	.0363	3.89	.6884	.0096	.057
Stockbridge,[1]	.21	.0715	2.74	.5391	.0079	.104
Westborough,[1]	.82	.0967	5.58	.5067	.0112	.527
WORCESTER,[10]	1.41	.1316	14.42	.9185	.0308	.747

[1] Regular samples from two or more underdrains combined in one average.
[2] Single samples of each examination made up of equal parts from two or more underdrains. December, May and September omitted.
[3] Samples from east and west underdrains.
[4] Every other month.
[5] December, May, February and November.
[6] December, January and May.
[7] Eight samples. January to April, inclusive, omitted.
[8] Nine samples.
[9] Seven samples.
[10] December, January, June, two in August, September, October.

NOTE. — Very little effluent has as yet appeared in underdrains at Attleboro. No samples taken. Concord effluent samples taken from spring.

TABLE No. 6. — *Efficiency of Sand Filtration (Per Cents. of Free and Albuminoid Ammonia removed).*

[Parts in 100,000.]

City or Town.	Free Ammonia.			Total Albuminoid Ammonia.			Chlorine.		Rate of Operation with Even Distribution (Gallons per Acre per Day).[1]
	Applied sewage.	Effluent.	Per Cent. removed.	Applied sewage.	Effluent.	Per Cent. removed.	Applied sewage.	Effluent.	
Andover,	3.21	1.64	49	.61	.1745	72	7.96	7.62	58,000
Brockton (sand filters used for screened sewage).	5.22	3.87	26	1.35	.1909	86	11.45	10.62	54,000
Brockton (sand filters used for settled trickling filter effluent).	2.93	2.64	10	.57	.1098	81	8.63	10.62	92,000
Clinton,	3.37	1.73	49	.85	.1260	85	5.56	5.47	40,000
Concord,[2]	2.07	.44	79	.58	.0370	93	4.16	4.17	121,000
Framingham,	5.17	1.98	62	1.93	.1393	93	19.91	11.98	40,000
Franklin,	1.66	.53	68	.31	.0363	87	3.39	3.35	56,000
Gardner (Gardner area),[3]	4.68	2.27	52	3.22	.2910	91	6.03	7.10	-
Gardner (Templeton area),	4.18	2.07	50	.75	.2355	68	6.17	7.09	67,000
Hopedale,	4.44	1.42	68	.73	.1355	81	4.99	4.73	29,000
Hudson,	5.73	1.40	76	1.33	.1570	88	21.22	20.23	34,000
Leicester,	2.28	.90	61	.49	.0920	82	4.47	2.92	-
Marion,	1.74	.29	83	.51	.0589	88	4.37	3.84	151,000[4]
Marlborough,	5.10	.93	82	.99	.0941	91	10.11	8.12	34,000
Milford,	4.10	1.55	62	.63	.1208	81	7.73	7.16	54,000
Natick,	3.59	2.14	40	.66	.1193	82	9.23	8.23	61,000
North Attleborough,	1.24	.03	10	.26	.0123	96	5.33	3.42	103,000
Northbridge,	1.88	1.05	44	.33	.1045	70	2.60	3.41	82,000
Norwood,	3.01	1.18	61	.66	.0959	85	23.73	17.23	109,000
Pittsfield,	2.48	.87	55	.66	.1134	83	4.74	4.10	87,000
Southbridge,	3.89	2.46	37	.66	.1195	82	6.01	5.64	105,000
Spencer,	3.09	.24	92	.76	.0363	95	4.47	3.89	48,000
Stockbridge,	.98	.21	79	.25	.0715	72	1.72	2.74	-
Westborough,	2.72	.82	70	.77	.0967	87	5.93	5.58	68,000
Worcester,	2.98	1.41	53	1.29	.1361	89	12.46	14.42	55,000

[1] See also Table No. 7.
[2] See note at foot of Table No. 5.
[3] These filters given long periods of rest when necessary.
[4] Sewage not all filtered.

TABLE NO. 7. — *Extent of Sewerage Works, Rate of Flow and Rate of Operation of Sand Filters, etc.*

CITY OR TOWN.	Population, 1915.	Approximate Length of Sanitary Sewers (Miles).	Approximate Number of House Connections.	Estimated Quantity of Sewage treated (Gallons per Day). Average for Year.	Estimated Quantity of Sewage treated (Gallons per Day). Average for Month of Maximum Flow.	Estimated Quantity of Sewage treated (Gallons per Day). Average for Month of Minimum Flow.	Estimated Average Quantity of Sewage per Connection (Gallons per Day).	Net Area of Filter Beds (Acres).	Estimated Rate of Operation with Even Distribution (Gallons per Acre per Day).
Andover,	7,978	12.69	833	212,000	354,000	134,000	255	3.65[1]	58,000
ATTLEBORO,	18,480	30.86	984	522,000	–	–	530	15.50	34,000
BROCKTON: —									
Filters for screened sewage,	62,288	82.81	6,096	1,609,000[2]	2,315,000	1,279,000	370	30.00	54,000
Filters for settled trickling filter effluent,				643,000[2]	905,000	480,000		7.00	92,000
Clinton,	13,192	–	–	1,050,000[2]	1,303,000	891,000	–	26.23	40,000
Concord,	6,681	8.68	458	400,000[2]	–	–	873	3.30	121,000
FITCHBURG,	39,656	55.40	–	3,134,000	–	–	–	–	–
Framingham,	15,860	25.71	2,265	857,000[2]	950,000	727,000	378	21.12	40,000
Franklin,	6,440	11.27	262	183,000	358,000	69,000	698	3.24	56,000
Gardner,	16,376	28.05	1,768	835,000	–	–	472	12.50[3]	67,000
Hopedale,	2,663	–	–	110,000[2]	155,000	–	–	3.79	29,000
Hudson,	6,758	9.68	614	307,000	372,000	232,000	500	9.00	34,000
Leicester,	3,322	–	–	–	–	–	–	.36	–
Marion,	1,487	–	–	113,000[2]	184,000	–	–	.75	151,000
MARLBOROUGH,	15,250	28.83	2,017	704,000	1,180,000	303,000	349	20.90	34,000
Milford,	13,684	17.53	1,198	501,000	646,000	307,000	418	9.30	54,000
Natick,	11,119	15.44	1,365	771,000[2]	1,364,000	394,000	565	12.60	61,000
North Attleborough,	9,398	16.19	513	719,000	815,000	673,000	1,401	7.00	103,000
Northbridge,	9,254	14.67	504	491,000	523,000	467,000	974	6.00	82,000
Norwood,	10,977	18.00	998	934,000	–	–	936	8.60[4]	109,000
PITTSFIELD,	39,607	59.97	4,621	3,589,000[2]	3,809,000	3,362,000	777	41.15	87,000
Southbridge,	14,217	16.20	1,079	894,000	1,699,000	491,000	829	8.50	105,000
Spencer,	5,994	–	–	450,000	–	–	–	9.30	48,000
Westborough,	5,925	9.53	547	396,000	532,000	299,000	724	5.80	68,000
WORCESTER,	162,697	180.42[5]	–	4,000,000[6]	–	–	–	72.60	55,000

1 A sludge bed with an area of .12 of an acre and four filter beds with an aggregate area of .37 of an acre under construction.
2 From pumping records.
3 Gardner area, 2.50 acres. Templeton area, 10 acres.
4 Two new beds with an aggregate area of 1.94 acres laid out but not ready for use.
5 Includes 69.58 miles of combined sewers.
6 Amount treated by sand filters. An average of 15,085,455 gallons per day treated by chemical precipitation.

TABLE NO. 8. — *General Features.*

[For data concerning the trickling filters at Brockton and Fitchburg see Table No. 4.]

CITY OR TOWN.	Year of Construction of and Additions to Works.	Depth of Underdrains (Feet).	Distance Apart of Underdrains (Feet).	Filtering Material.	Attention given to Disposal Works.
Andover,	1898	4	20	Fair sand, small quantity of gravel; practically all handled in construction.	One man greater part of time.
ATTLEBORO,	1912, 1913	4–7	35	Excellent sand and gravel; found in place,	One man all the time; others when necessary.
BROCKTON,	1893, 1905, 1908, 1912	5.5	30	Good sand and gravel; found in place,	Four men all the time; large force when necessary.
Clinton,	1898, 1899	8	60–70	Good sand and gravel; found in place,	Two men all the time; others when necessary.
Concord,	1899	none	–	Good sand underlaid with gravel; found in place,	One man once a day.
Framingham,	1890	4–4.5	30–40	Good sand and gravel,	Three or more men in summer; only one in winter.
Franklin,	1915	4.5	26	Good sand and gravel,	One man every two or three days; others when necessary.
Gardner (Gardner area),	1891	5	20	Good sand; handled in construction,	One man all the time.
Gardner (Templeton area),	1901, 1909	3–4	20–30	Coarse sand; handled in construction,	One man all the time; more when necessary.
Hopedale,	1900	3	35–60	Some good sand and some rather fine sand,	One man all the time.
Hudson,	1904, 1910	5–6	50–100	Good sand and gravel; found in place,	One man all the time; others when necessary.
Leicester,	1894	4	8	Hard, compact sand; found in place,	Very little attention.
Marion,	1906	5	–	Mostly good sand; pockets of fine sand and some ledge; largely found in place.	One man every day in summer; every other day in winter.
MARLBOROUGH,	1891, 1908, 1909, 1910, 1911	4.5–6	30–50	Rather fine sand; found in place,	One man all the time; others when necessary.
Milford	1907	5	40	Rather fine sand; found in place,	One man every day; others when necessary.
Natick,	1896	6	36	Sand of good quality, but strata of very fine sand in places; found in place.	One man all the time; others when necessary.
North Attleborough,	1909, 1910	5–6.5	55	Coarse sand and gravel; largely found in place,	One man every day; others when necessary.
Northbridge,	1906, 1907	4	50–75	Coarse sand and gravel; found in place,	One man all the time; others when necessary.
Norwood,	1909	4–6	40	Good sand and gravel; found in place,	One man every day; others when necessary.
PITTSFIELD,	1901, 1915	4	35	Good sand; mostly found in place,	Two men all the time; others when necessary.
Southbridge,	1908	4	40	Fair sand and gravel; considerable quantity handled, some found in place.	One man once a day.
Spencer,	1897	–[1]	–	Good sand and gravel; largely found in place,	One man all the time; others when necessary.
Stockbridge,	1899	3–4.5	23	Sand filters, good quality sand,	One man all the time.
		3–4.5	30	Irrigation area, rather fine sand,	
Westborough,	1892, 1911	5	30–40	Good sand and gravel; handled during construction,	One man all the time; others when necessary.
WORCESTER,	1898[2]	4–6	35–50	Good sand and gravel; largely found in place,	Several men all the time; a large force when necessary.

[1] Only 3 beds underdrained.

[2] Year of first construction of sand filters. Many additions.

Division of Water and Sewage Laboratories.

H. W. Clark, *Director and Chief Chemist.*

Report of the Division of Water and Sewage Laboratories.

The work of the Divison of Water and Sewage Laboratories, carried on very largely in laboratories in the State House, and at the experiment station and its laboratories at Lawrence, was performed as usual during the year 1917. This Division does all of the analytical and much of the investigation work demanded by the provisions of the act entitled "An Act to protect the Purity of Inland Waters of the State." Analytical work, including chemical, bacteriological and microscopical analyses, is also called for by many special acts having to do with public welfare and public health as related to water supply, sewerage, condition of rivers, etc.

In performing this work examinations were made during the year of the waters of practically all the public water supplies in the State, of the rivers at different points, of the sewage applied to, and of the effluents from, sewage disposal areas in the State, and of wastes from factories, together with many samples of effluent from the purification works at these factories, from experimental purification plants, etc.

During 1917, 5,202 samples were analyzed at the State House laboratories, divided approximately as follows: —

Samples from public water supplies: —	
Surface waters,	1,508
Ground waters,	1,047
Samples from rivers,	1,340
Samples from sewage-disposal works, sewer outlets, etc.: —	
Sewage,	471
Filter effluents,	563
Samples of wastes and effluents from factories,	166
Sea waters and miscellaneous samples,	107
	5,202

Further Analytical Work.

Special examinations for lead, manganese, copper and zinc,	148
Special examinations (field work) for carbonic acid and dissolved oxygen,	471
Examinations for fats and alkalinity,	542
Microscopical examinations,	1,543

The results of practically all of this analytical work are presented in the report of the Division of Sanitary Engineering in connection with answers to applications to the Department for advice concerning water supplies, sewage disposal, etc., or data concerning the inspection and observations of water supplies, sewage areas, rivers, harbors, etc. Tables summarizing much of this work are given on preceding pages.

Much investigating work is carried on by this Division concerning methods of treatment or purification of water, sewage, factory wastes, etc., and many filters and other apparatus are kept in operation at the experiment station for this purpose.

At the station 2,493 samples were examined in carrying out work, which may be generalized as follows: —

Samples examined chemically on account of investigations concerning the disposal of domestic sewage and factory wastes,	1,701
Samples examined chemically on account of investigations in connection with filtration and other treatments of water supplies,	561
Samples of sand examined chemically and mechanically,	231
	2,493
Bacterial examinations,	4,185
Total number of samples examined by the Division,	14,584

The samples examined bacterially were of water, ice, sewage, sewage effluents, factory wastes, shellfish, etc., forwarded by the Division of Sanitary Engineering, or samples examined in connection with studies by this Division of the treatment or methods of purification of water, sewage, factory wastes, etc.

Special studies were made during the year on the following subjects: —

1. Treatment of Ipswich River water with chlorine (Beverly and Salem water supply).
2. Filtration of Wenham Lake water through sand filters.
3. Studies of methods for the removal of color from water.
4. Studies of corrosion of service pipes.
5. Studies of the improvement of the Lawrence water supply.
6. Studies of the purification of water by chloramine, so called.
7. Studies of the treatment of Boston sewage with SO_2 for the recovery of sludge, fats, etc.
8. Studies of wastes from gelatin works, from the washing and bleaching of cloth, and from a paper box factory; and of the action of pickling liquors, so called, from foundries upon concrete and Akron pipe.

9. Studies of the hydraulics of the passage of sewage through settling and activated sludge tanks.

10. Studies of the activated sludge process of sewage purification; and many minor studies either reported upon to the Department or found in the following pages.

The personnel of the Division at the end of the year was as follows: —

Director of Division and Chief Chemist.

H. W. Clark.

Principal Assistant Chemists.

Fred B. Forbes (State House Laboratories).
George O. Adams (Lawrence Experiment Station).

Assistant Chemists and Bacteriologists.

State House Laboratories: —
Arthur R. G. Booth.
Arthur F. Harkness.
Lester W. Stickney.
Guy G. Russell.
John J. May.
Henry H. Andersen.

Lawrence Experiment Station: —
James H. Spurr.
William J. Magee.

Laboratory Assistants.

Allen M. Symonds (State House Laboratories).
George E. Parkhurst (Lawrence Experiment Station).

Stenographer.

Isabelle J. Pratt.

Clerk.

Annie E. Holton.

Filter Attendant.

Patrick Keegan.

Investigations in regard to Purification of Sewage and Water at the Lawrence Experiment Station during the Year 1917.

Character of the Sewage used at Lawrence.

Since September, 1915, the sewage used at the station has been pumped from the Osgood street sewer, so called, a sewer serving a district occupied very largely by dwelling houses and stores. Recently, however, a plant erected for the recovery of potash and grease from wool-scouring liquor has, by discharges of waste, changed the character and strength of the sewage pumped, the sewage being strengthened at times by liquor containing much organic matter coming from this plant, and at other times diluted very greatly by discharges of condenser water. These waste liquors came only at intervals, hence practically all that coming to the station could be wasted and not mixed with the sewage used. In order, however, to be free from these wastes, the pipe from the station to the sewer was extended in November a distance of 450 feet past the point of discharge of all liquors from the recovery plant. Since that date the sewage pumped to the station has been entirely domestic sewage, and fully equal in strength to that formerly pumped from the Lawrence Street sewer, averaging at the present time nearly 1 part in 100,000 albuminoid ammonia.

In this report, "regular station sewage," so called, is the average of samples collected four times each day of the sewage as it reaches the experiment station; "settled station sewage" is the same sewage settled for at least two hours in a cylindrical tank; sewage applied to Filters Nos. 1, 6 and 9A is the average of daily samples of all the regular station sewage applied to the large intermittent filters situated out of doors.

The average analyses of the various representative samples of sewage collected during the year are shown in a following table.

Clarification of Sewage.

No special studies were made of sedimentation during the year, partly because the sewage contained an abnormal amount of fine grit, probably discharged from the plant treating wool-scourings, and partly because the open tanks formerly used for sedimentation were used as feed tanks for the aeration tanks.

Precipitation with Sulphate of Alumina.

Throughout the year sewage was treated daily with sulphate of alumina at an average rate of 6.3 grains per gallon. After settling four hours, the clarified sewage was applied to a trickling filter and to a sand filter, and the results are given in a subsequent portion of this report. The average removal of total suspended matter was 68 per cent., and of total organic matter, 57 per cent., as shown by the determinations of solids.

Average Analyses.

Regular Station Sewage.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Oxygen consumed.	Bacteria per Cubic Centimeter.
Free.	Albuminoid.						
	Total.	In Solution.	Total.	In Solution.			
1.90	.61	.38	1.25	.77	3.90	5.02	1,150,000
Settled Station Sewage.							
1.51	.41	.30	0.85	.60	3.37	3.40	960,000
Sewage applied to Filters Nos. 1, 6 and 9A.							
1.69	.41	–	0.90	–	3.57	3.56	–
Sewage precipitated with Sulphate of Alumina.							
1.19	.25	.17	0.70	.45	3.36	2.02	120,000

Average Solids.

Regular Station Sewage.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
62.5	33.0	29.5	39.0	19.2	19.8	23.5	13.8	9.7
Settled Station Sewage.								
47.4	24.2	23.2	31.6	15.1	16.5	15.8	9.1	6.7
Sewage precipitated with Sulphate of Alumina.								
34.4	14.1	20.3	27.0	9.8	17.2	7.4	4.3	3.1

Purification of Sewage by Aeration and Growths (Activated Sludge).

Purification of sewage by the activated sludge process is now in its fifth year of development. It is essentially a Lawrence process. Although purification of sewage by aeration had been attempted by many workers at Lawrence and elsewhere during the past thirty years, it had never been successful. It was shown at the Lawrence Experiment Station, however, in 1912, that aeration, aided by developed growths, bacterial or algal, caused satisfactory purification. The retention of these growths day after day in the tank to which sewage was added daily for aeration was an absolutely new development in sewage purification. In all previous experiments on the purification of sewage by aeration the tanks for holding the sewage being treated were emptied each day, not only the sewage being drained from them but everything in the nature of growths and sludge also. The Lawrence discovery was that certain growths when retained day after day in these tanks acted in conjunction with aeration upon each lot of fresh sewage introduced, and actually purified the sewage. It was found that if the treatment was carried on long enough nitrification ensued, and that even when nitrification did not occur the sewage could be clarified and rendered stable. This retention of growths and sludge is the primary or essential difference between aeration alone and what is now known as purification by aeration and growths, or, as first termed by English workers, the "activated sludge process."

The first work carried on with gallon bottles was described in the

Lawrence report for 1912 and shown to English visitors during that year, and since then the method has been developed at Lawrence and elsewhere in this country, and abroad. A résumé of the work at Lawrence during 1912, 1913, 1914, 1915 and 1916 has been given in the Lawrence reports for those years. During 1917 further studies were made at Lawrence and greater knowledge of the process was gained. Tanks containing layers of slate were continued in operation, and new and larger activated sludge tanks were also operated.

Aeration in Slate Tanks.

Tanks Nos. 449 and 449B. — Slate aerating Tank No. 449, started in January, 1913, was continued until March 8 of this year, when the slates were transferred to a new, larger tank, No. 486. During the three months that it was operated in 1917, air was applied for three hours daily at the rate of 150,000 cubic feet per hour per million gallons of sewage, or a total of .45 cubic foot of air per gallon of sewage treated. The removal of suspended solids from the sewage by the tank was 85.6 per cent., and 78 per cent. of the samples of effluent tested were stable.

Slate aerating Tank No. 449B was also stopped in March. While operated, it received the effluent from slate Tank No. 449, and was aerated for three hours daily at the rate of 50,000 cubic feet per hour per million gallons of sewage, or a total of .15 cubic foot of air per gallon of sewage treated. The removal of suspended solids, including those removed in Tank No. 449, was 91.3 per cent., and 100 per cent. of the samples were stable; that is, the use of .68 cubic foot of air in these tanks per gallon of sewage treated gave these remarkable results.

Slate Tank No. 486. — This aerating tank was started on March 20, and is a three-compartment concrete tank, each compartment being 2 by 4 by 3 feet and holding about 185 gallons, making a total of 555 gallons for the entire tank. The bottom of each compartment slopes slightly on three sides to a 9 by 12 inch filtros air distribution plate set in concrete.

Sewage is applied continuously to the first compartment and flows through the three compartments to an outlet in the last. Each compartment contains 33 slates, 12 by 24 inches, held 1 inch apart by concrete blocks. About 23 per cent. of the tank is occupied by the slates. The average theoretical period of retention of sewage in the tank while running continuously was five hours and fifteen minutes. The number of hours the tank could be operated each day was limited by the size of the tanks supplying the sewage at night, and it averaged

about nine hours. Air was applied at the rate of 150,000 cubic feet an hour per million gallons of sewage treated, or a total of about .79 cubic foot of air per gallon.

During July, August and September the last two compartments of this tank were operated continuously, and the first on the fill and draw plan, — one cycle daily with six hours' aeration. During this period the average removal of suspended solids by the first compartment was 87.6 per cent., and by the second and third compartments, 23.3 per cent. The per cent. of samples stable was the same for both, namely, 66 per cent. The tank was not operated during the months of October and November.

Aeration in Activated Sludge Tanks.

Activated Sludge Tank No. 484. — This tank, which was described in the report for 1916, was started in August, 1916, and stopped on March 1, 1917. During December, 1916, and January, 1917, it was operated one cycle daily on the fill and draw plan, with air at the rate of 150,000 cubic feet per hour per million gallons for three and one-half hours, or a total of .53 cubic foot of air per gallon of sewage treated. The sludge remaining in the tank was aerated continuously. During the two months of operation the removal of suspended solids by the tank was 84.5 per cent., and all samples of the effluent were stable.

Activated Sludge Tank No. 485. — On April 10 a new activated sludge tank, No. 485, was started on the continuous operation plan. This tank consists of three compartments made with sections of 30-inch Akron pipe set in concrete bases. The compartments are about 75 inches deep above conical bottoms, and have a capacity of 230 gallons each, or a total of 690 gallons for the entire tank. These compartments are connected at the top in series, and the first two have wooden baffles, about 3 feet deep, across the centers. The overflow from the last compartment is piped to a square, concrete-cased, iron settling tank 92 inches deep, and enters about 42 inches from the bottom at the point where two of the sides begin to slope in a 2½-inch to a 1-inch slope. Twice a day the sludge accumulating in this settling tank is pumped back to the first compartment of Tank No. 485. After August 1 the sludge was drawn at intervals of an hour or so into a 200-gallon iron tank, where it was aerated with about the same proportion of air as in the main tanks until it was pumped back to the first compartment.

The tank mentioned above holds about 600 gallons. This allowed from six to seven hours' retention for sedimentation, considering the rate of operation of Tank No. 485. This period of settling proved

insufficient to remove the lighter particles of sludge; hence, beginning on October 8, the overflow from this tank was further settled by being passed upward through a tank 10 feet deep, holding 160 gallons. This gave further improvement, but the final effluent still contained suspended solids equal to about 5 parts in 100,000.

During July, August and September the first compartment of Tank No. 485 was operated on the fill and draw plan, one cycle daily with six hours' aeration of the sludge; the second and third compartments were operated continuously, as before. During this period the first compartment removed 81.7 per cent. of the suspended solids, the second and third, 53.5 per cent., and 78 per cent. of the samples of effluent from each were stable. The average theoretical retention of sewage in this tank during the year was six hours and fifteen minutes.

The volume of air applied was 150,000 cubic feet an hour per million gallons of sewage, or a total of .94 cubic foot per gallon, until October 1, when it was increased to 350,000 cubic feet an hour, or a total of 2.19 cubic feet per gallon of sewage. These volumes of air, as figured, are based on the capacity of the tanks and not on the volume of sewage actually passing through in an hour. At first, filtros plates were used for air distributors, but, owing to frequent clogging, perforated, hollow, circular discs, 5 inches in diameter and 1 inch thick, were substituted. These gave little trouble from clogging, but did not divide the air as finely as the filtros plates.

It is evident that the amounts of air applied to these tanks during the year were insufficient, but they represented the capacity of the air compressor used. A more efficient air pump was planned late in the summer, but, owing to war conditions, it was impossible to obtain it up to the end of the year.

There was very little dissolved oxygen in either of these tanks while in active operation. No accurate measurements of the amount of sludge in the compartments were made, but about 20 per cent. of the contents was sludge, and none was withdrawn during the year. On the whole the effluent from these two tanks was not of as good quality as that from similar tanks operated on the fill and draw plan at the station. The time that sewage actually remains in a continuous flow tank undoubtedly has a bearing on this. It is generally assumed that the theoretical retention of sewage in a tank is practically the actual retention, but in another section of this report it will be shown that this is not true, even in well baffled tanks. Some of the raw sewage passes through in a much shorter time, and some is retained a much longer time. The raw sewage passing through quickly affects adversely the quality of the effluent produced.

Summary of Aeration Work.

In considering this entire subject of purification by aeration and growths it becomes increasingly evident, as stated in previous reports, that different sewages and sewages of different strength require very different periods of time and volumes of air if satisfactory results are to be obtained. The resulting effluent is, speaking broadly, — unless excessive volumes of air and periods of time be given, — a modified sewage but not a purified sewage. It is also evident that tanks operated on the fill and draw principle can be more efficient with a unit volume of air and time than tanks operated on the continuous principle. It is also evident that tanks constructed like Tanks No. 449 and No. 449B, that is, containing slate, produce purification with but a fraction of the air necessary in tanks similar to Nos. 485 and 486. Studies of sludge, not sufficiently developed as yet to summarize, seem to show that it is easy in this process to use an uneconomical and, in fact, detrimental percentage of sludge, and that good results cannot be obtained unless sufficient air is used to produce sludge of a certain color and physical and chemical character.

Average Analyses.

Sewage applied to Activated Sludge Tank No. 485 and Slate Aerating Tank No. 486.

[Parts in 100,000.]

Color.	Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Nitrogen as —		Oxygen consumed.	Bacteria per Cubic Centimeter.	Per Cent. of Samples Stable.
	Free.	Albuminoid. Total.	Albuminoid. In Solution.	Total.	In Solution.		Nitrates.	Nitrites.			
-	1.67	.57	.36	1.06	.71	3.30	-	-	4.47	1,167,000	-

Effluent from Activated Sludge Tank No. 485.

1.19	1.12	.31	.23	0.67	.47	3.77	.02	.0063	2.88	812,000	77.8

Effluent from Slate Aerating Tank No. 486.

1.58	0.99	.32	.24	0.64	.47	2.53	.03	.0077	2.51	553,000	65.6

Average Solids.

Sewage applied to Activated Sludge Tank No. 485 and Slate Aerating Tank No. 486.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
58.6	30.7	27.9	41.1	20.5	20.6	17.5	10.2	7.3
Effluent from Activated Sludge Tank No. 485.								
42.6	20.3	22.3	35.9	16.0	19.9	6.7	4.3	2.4
Effluent from Slate Aerating Tank No. 486.								
43.2	21.6	21.6	35.3	16.6	18.7	7.9	5.0	2.9

Organic Nitrogen in Activated Sludge.

In the last report the question of the increase of organic nitrogen in activated sewage sludge was considered, and the statement made that the increase was largely due to the high nitrogen content of the colloidal matter deposited in the activated sludge from sewage, possibly aided by an apparent increase of nitrogen due to removal of carbonaceous matter by oxidation. The oxidation of the carbonaceous matter by aeration was studied at some length during the year, as follows.

Studies of Destruction of Organic Matter by Oxidation.

A gallon bottle with rubber stopper and delivery tubes was used in the laboratory as a miniature activated sludge tank, and operated on the fill and draw plan, — one cycle daily with three and one-half hours' aeration and one and one-half hours' settling. The air applied to this small activated sludge tank was thoroughly freed from carbon dioxide by being passed through bottles filled with caustic soda, and the air leaving, and carrying carbon dioxide formed by oxidation of the organic matter, was passed through four bottles in series, containing measured volumes of standard barium hydrate solution. The carbon dioxide was absorbed and precipitated as barium carbonate. The barium hydrate solution was withdrawn twice daily, and, after allowing the barium carbonate to settle, it was titrated and replaced with a fresh solution. The decrease in strength was proportional to

the amount of carbon dioxide absorbed. Tests showed that the absorption of carbon dioxide was complete from the air entering and leaving the sludge bottle. Dissolved carbon dioxide in the applied sewage and in the aerated sewage was determined and taken into account in calculations. From the carbon dioxide found, the organic matter being digested was calculated, assuming that 40 per cent. is carbon in this organic matter, and by actual combustion analyses of sludges in the past it has been found that this is a close approximation.

It was found by this work that organic matter equivalent to 56 per cent. of that deposited in the bottle from the applied sewage was oxidized in eight weeks. There was 2.36 per cent. of organic nitrogen in the suspended solids deposited from the sewage, and 5.64 per cent. in the colloids; in the combined deposits it was 3.26 per cent. If no nitrogen had been carried out by the air, either as ammonia or free, the activated sludge should have contained 3.87 per cent. nitrogen, or, allowing for concentration due to the oxidation of carbonaceous matter, 4.78 per cent. nitrogen, at the end of eight weeks. Three and three-fourths per cent. nitrogen was actually found, and this would indicate that there is a considerable loss of nitrogen, probably as free nitrogen in the activated sludge process. A similar loss of free nitrogen takes place in all forms of sewage filtration.

Other experiments indicate that the amount of this loss varies. Four samples of raw sludge, settled from station sewage, were collected at different times and aerated on an average of three weeks in the laboratory. Two samples showed a decrease and two an increase in the nitrogen content. The decreases were the smaller, as the average for the four was an increase of .17 per cent. nitrogen.

Effect on Activated Sludge of Sterilizing Chemicals.

Another miniature activated sludge tank was operated at the same time as the one just described, to study the effect on activated sludge of sterilizing chemicals. At first chloroform was used, 5 cubic centimeters being added twice daily. This reduced the number of bacteria without, however, sterilizing the sludge and sewage, and prevented the successful operation of the tank. Mercuric chloride effected complete sterilization and completely stopped the action of the activated sludge; that is, no purification occurred.

Effect of the Reaction of Sludge on its Oxidation by Aeration.

It was noticed in the laboratory experiments that when sewage, alkaline to phenolphthalein, was aerated with activated sludge, very little oxidation took place. This, and the fact that most bacteria

grow more readily on slightly acid than on neutral or alkaline media, suggested that a slight acidity might be favorable to bacterial growth and oxidation.

A portion of sewage sludge was divided and placed in two gallon bottles. One was made about 1 part acid with sulphuric acid and the remainder about 3 parts alkaline. Both were aerated continuously for two weeks, the carbon dioxide evolved being determined by absorption in barium hydrate. The amount of organic matter oxidized was calculated from the carbon dioxide. The mineral acid changed the appearance of the sludge; that is, it became light colored, lost its flocculent appearance, etc.

Although mineral acid is used in the preparation of culture media, it is probable that in the media as used, the only free acids present are organic. Oxidation in the acid sludge was not as great as in the alkaline sludge, in two weeks 4 per cent. of the organic matter being oxidized, while in alkaline sludge, 4.8 per cent. was oxidized. In a similar experiment, in which acetic acid was substituted for sulphuric acid, 13.7 per cent. of the organic matter was oxidized in the acid sludge and 11.5 per cent. in the alkaline sludge. Acetic acid did not change the appearance of the sludge as did the sulphuric acid, but it was necessary to keep adding acid as it was rapidly oxidized. In all, an amount equivalent to 72.2 parts calcium carbonate was added.

Effect of adding Ferrous Hydrate to Sludge which is to be aerated.

Considering the stabilizing effect of iron salts on sludge in Imhoff tanks, it was thought that they might help in the aeration of sludge; hence two bottles of sludge were aerated three weeks, and the organic matter oxidized determined by measurement of the carbon dioxide evolved To one bottle ferrous hydrate, equivalent to 2 per cent. of the weight of the dry sludge, was added. In the control bottle 14.7 per cent. of the organic matter was oxidized, and in the bottle containing the iron 20.3 per cent. was oxidized. These experiments are being continued.

Stabilizing Sewage Sludge by Oxidation with Nitrates from Sewage Filter Effluents.

An experiment in regard to the stabilizing of sludge by effluents rich in nitrates has been carried on for the past two years, this being done because it seemed probable that offensive sludge, now a nuisance on account of odors, might at certain disposal areas be treated in this manner and rendered inoffensive. In carrying out this work all the

sludge collected from the settling tanks at the station was run into Tank No. 483, made of Akron pipe set in concrete, with three compartments, 4 feet deep, connected in series, each holding about 65 gallons. All the sludge collected during one month was put into one compartment of Tank No. 483, and, as the compartments were used in rotation, a maximum storage of three months was given. The inlets and overflows of this tank were so arranged that the applied effluents passed through all three compartments, entering at the bottom and leaving about 6 inches below the surface of each.

The greater part of the effluent used during the year came from trickling filters, although some contact and sand filter effluents were also applied. The average daily volume applied was two-thirds of a volume of effluent for each volume of sludge containing 5 per cent. of solids in the compartments. Part of the time the effluents from as many as four filters were applied to this tank, and, averaging the stability of these as well as possible, it was noted that the applied effluent had about the same stability as the overflow from the tank, and 72 per cent. of the samples of overflow were stable.

The sludge placed in this tank during the year contained about 60 per cent. of mineral matter, which was a larger amount than usual. A considerable proportion of this matter was fine sand which had a tendency to cause the sludge to pack solidly, so that the nitrates did not always come in good contact with this sludge. After four weeks' storage, however, the sludge was always inoffensive, being equal to activated sludge in this respect, and the tank was always practically odorless.

Average analyses of the applied filter effluents, of the overflow from the last compartment, and sludge analyses on a dry basis are shown in the following tables: —

Effluents applied to Tank No. 483.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.	Nitrogen as —		Oxygen consumed.
Free.	Albuminoid.					
	Total.	In Solution.		Nitrates.	Nitrites.	
.61	.31	.21	.57	.76	.0150	2.66

Overflow from Tank No. 483.

.87	.22	.15	.42	.09	.0246	1.69

Sludge Analyses.

	Per Cent.		
	Fats.	Nitrogen.	Loss on Ignition.
Activated sludge from Tank No. 485,	14.4	5.85	57.5
Sewage sludge applied to Tank No. 483,	19.4	1.30	40.0
Sludge from Tank No. 483: —			
After four weeks' treatment,	17.0	1.53	40.3
After eight weeks' treatment,	14.1	1.71	39.0
After twelve weeks' treatment,	11.9	1.74	40.6

Stabilizing of Sewage by Dissolved Oxygen aided by Aeration and the Oxygen of Nitrates.

During the year a study was made, in connection with the activated sludge work carried on, in regard to the actual amount of oxygen necessary to stabilize sewage of average strength, and the time necessary for such stabilization to occur. In this study five 1-gallon samples of station sewage, divided into two equal portions, were treated and stabilized: (1) by incubation at 70° F. with an excess of dissolved oxygen, and (2) by incubation at 70° F. with nitrates. As fast as the dissolved oxygen in the first series of experiments was consumed and exhausted by the organic matter more oxygen was added by blowing air into the bottles, the only error likely to occur in doing this being the possibility of blowing out from the liquid some volatile organic matter. It was found that eleven days was the shortest and twenty days the longest period of incubation necessary in this work, stability being determined by the methylene-blue test. At the end of the period of incubation all of the samples of sewage treated had the appearance of good, clear trickling filter effluents.

The following table shows partial analyses of each sample before and after incubation with dissolved oxygen and nitrate oxygen. In studying this table it must be remembered that it includes the results of ten incubations, as noted above, — five with dissolved oxygen and five with nitrate oxygen. The results obtained show that the average amount of dissolved oxygen necessary to produce stability in these sewages was 4.26 parts in 100,000, or $4\frac{1}{4}$ pounds per 12,000 gallons. This means about 350 pounds of oxygen per million gallons of sewage. When in the activated sludge process, however, sewage is aerated at the rate of 2 cubic feet per gallon of sewage, it means the use or rather

the waste, of 37,240 pounds of oxygen per million gallons of sewage, — one hundred times the amount required to produce the stability in these experiments.

[Parts in 100,000.]

Sample Number.	Days Incubated to produce Stability.	Oxygen absorbed from—		Albuminoid Ammonia in Solution.			Oxygen consumed.		
					After incubation with —			After incubation with —	
		Dissolved Oxygen.	Nitrates.	At Start.	Dissolved Oxygen.	Nitrates.	At Start.	Dissolved Oxygen.	Nitrates.
1,	20	5.54	7.09	.20	.07	-	2.64	1.68	4.70
2,	14	3.60	12.40	.30	.09	-	3.80	2.60	6.20
3,	12	2.13	3.35	.23	.30	.23	2.16	1.68	5.80
4,	15	4.70	4.62	.09	.05	.04	2.50	3.20	2.08
5,	11	5.31	3.57	.28	.13	.12	3.16	3.36	3.16

In the first samples a large excess of nitrate was added at the start, and more was used than was necessary to make the sewage stable. In the last two samples, however, small amounts were added from day to day as the methylene blue in the test bottles became decolorized. The high "oxygen consumed" in the first three nitrated samples of sewage is noticeable, and it is probable that the bacteria converted the surplus nitrates to organic nitrogenous bodies, which increased the oxygen consumed from permanganate.

Apparently the oxygen available from nitrates is as efficient as dissolved oxygen. The stabilizing property of nitrates was made use of in treating, during the summer, an insufficiently purified tannery effluent which flows into a small sluggish river.

A Study of the Method and Time of Passage of Sewage through Activated Sludge and Other Tanks.

In speaking of the time for sedimentation when liquid containing suspended matter passes through a settling tank, or of the time of passage of sewage through an activated sludge tank, the time is expressed invariably as the actual time which it would take to fill a tank of the capacity of those being described and used. That is, if we say that an activated sludge tank of the continuous-flow type is so operated that the sewage is six hours in passing through, we mean that the sewage is entering and leaving at a rate which should fill and empty the tank every six hours.

Studies of the passage of a liquid through tanks as affecting sedimentation in water and sewage purification have been made by a number of observers, and the different factors affecting this passage and the resultant sedimentation have been described at length. Chapters on sedimentation, etc., including observations in regard to the work of various investigators, are given in Fuller's book on "Sewage Disposal," and also in "American Sewerage Works," Vol. 3, by Metcalf and Eddy. One of the first studies along this line was made by Schmidt at Oppeln; in the "Journal of the Association of Engineering Societies," 1889, page 477, a paper is given by Seddon on "Clearing Water by Settlement;" and in the "Transactions of the American Society of Civil Engineers," Vol. LIII, 1904, page 46, there is an article by Hazen concerning sedimentation from a mathematical standpoint. Work of this nature has also been described by Dunbar, Steuernagel, Bock and Schwarz.

During 1917 determinations were made at Lawrence of the actual rate and manner of flow of liquids through activated sludge Tanks Nos. 485 and 486, when these tanks were being operated at such theoretical rates that the sewage was six, nine and one-half and ten and one-half hours, etc., in passing through. In this study the liquid entering was so treated with a chemical, either salt or ammonium chloride, that its appearance at the outlets of the tanks could be easily determined, and also the proportion which the effluent contained at all times during the period of experiment of the sewage so treated passing into the tank, and of the sewage held in the tank when the experiment was started.

A diagram showing the results of this work is given on page 139. At the time of two of the experiments illustrated, Tank No. 485 consisted of three main sections, as previously described in this report, and during another experiment two of these sections contained a baffle across their center reaching 3 feet below the surface of the sewage in the tanks, the main sections of the tank being each 8 feet in depth above conical bottoms. When the experiments were made, air was being applied at the rate of 150,000 cubic feet per hour per million gallons of sewage passing through, and, of course, the entire depth of liquid in all sections was in a state of quite violent agitation. Making experiments in this way and studying the results, it was found in one experiment with Tank No. 485, for instance, that while the theoretical time of filling and emptying this tank, when sewage was applied at the rate followed, was ten and one-half hours, yet certain volumes of the applied sewage appeared at the outlet of the tank in practically one hour; 50 per cent. appeared in seven and one-half hours, while the

remaining 50 per cent. lagged to such an extent that only after the expiration of thirty-five hours had all finally passed through this activated sludge tank. That is, the effluent from this tank was always a mixture of applied and held sewage, some of this sewage being treated in the tank for a short period, while some of it was treated for periods of from twenty to thirty-five hours.

On the diagram a second curve is given showing the theoretical mixture of applied and held sewage when sewage is passed into the tank at the rate followed during the experiment just described, and the liquid in the tank, considering it all as one compartment, is being thoroughly agitated. It will be noticed that this second curve, that is, the curve of the actual action of the sewage in passing through, and the theoretical curve are very similar. That is, instead of passing through as a more or less compact body of liquid, as generally assumed, it is passing through as a progressive mixture. Theoretically, when the tank is being operated on a ten-hour storage basis and a mathematically progressive mixture is taking place, 10 per cent. of the entering sewage should appear at the outlet of the tank in the first hour, 9 per cent. additional the second hour, and 8.1 per cent. additional the third hour, etc., or, expressing it in another way, a total of 10, 19 and 27.1 per cent. should appear at the end of the first, second and third hours, respectively. These amounts are probably not absolutely correct, but only higher mathematics can express them more exactly.

The diagram also shows experiments and observations of this nature when the sewage was passing through a second baffled tank (No. 486) theoretically in six hours; that is, enough sewage was being passed in to fill and empty this tank in six hours.

These results show plainly that when both Tanks Nos. 485 and 486 contained baffles, 50 per cent. of the applied sewage passed through in about four hours, while the remaining 50 per cent. did not entirely pass away from the tank until the elapse of twenty hours.

All of these data illustrate the fact that in activated sludge tanks agitated with air, even although divided into sections and baffled, sewage does not pass through in any sense in a body, but the entering sewage is continually mixing with sewage held in the tank.

The Passage of Liquid through Tanks not agitated with Air.

Further experiments were made using a tank 31 feet long, 31 inches wide and 30 inches deep (Tank K). This tank was baffled in such a way that the entering liquid passed below the first baffle, and at the outlet end of the tank rose above the second baffle before reaching

the outlet. Passing a liquid into this tank in a series of experiments, so that theoretically it should be four, six and eight hours in passing through if passing as a solid body, the results were practically the same as with the activated sludge experiments just described, and these results are illustrated on the diagram on page 140.

Curves on this diagram show that with the four-hour period only 50 per cent. of the entering liquid reached the outlet in four hours, while the remaining liquid lagged to such an extent that it was fifteen hours before all had passed from the tank. The six-hour and eight-hour experiments show similar results. In this wooden tank the temperature of the water in different parts and depths of the tank varied to a considerable extent, as shown by the following table, and these differences in temperature, of course, caused water to pass in more or less stratified layers.

The temperatures of the water in the tank and of the applied canal water are given below for each run.

Run Number.	Temperature of Water in Tank.	Temperature of Canal Water.	Place of Application of Canal Water.
1,	49	52	Bottom of tank.
2,	44	49	Bottom of tank.
3,	42	49	Bottom of tank.
4,	38	44	Behind baffle 15 inches high at bottom of tank.
5,	41	44	Behind baffle 15 inches high at bottom of tank.
6,	39	42	Behind baffle 15 inches high at bottom of tank.

The outlet was 3 inches below the surface. The tank was operated for thirty minutes or more in the last three runs before samples were taken; that is, the proper amount of ammonium chloride solution was added to the entering canal water during that time. Samples were collected from the top, bottom, each end and from the middle of the tank at the beginning of the experiment and after certain intervals. Determinations of ammonia in these samples show to what extent stratification took place.

Much further work along this line is being carried on and will be summarized eventually.

Per Cent. of the Original Amount of Ammonia in Different Parts of the Tank after Different Periods of Operation.

Run No. 1. — Four-hour Storage.

After Operating Tank (Hours).	Inlet.		Middle.		Outlet.	
	Top.	Bottom.	Top.	Bottom.	Top.	Bottom.
4½,	38	40	53	50	56	51
9,	11	5	6	13	20	16

Run No. 2. — Six-hour Storage.

8½,	43	23	43	23	23	43

Run No. 3. — Eight-hour Storage.

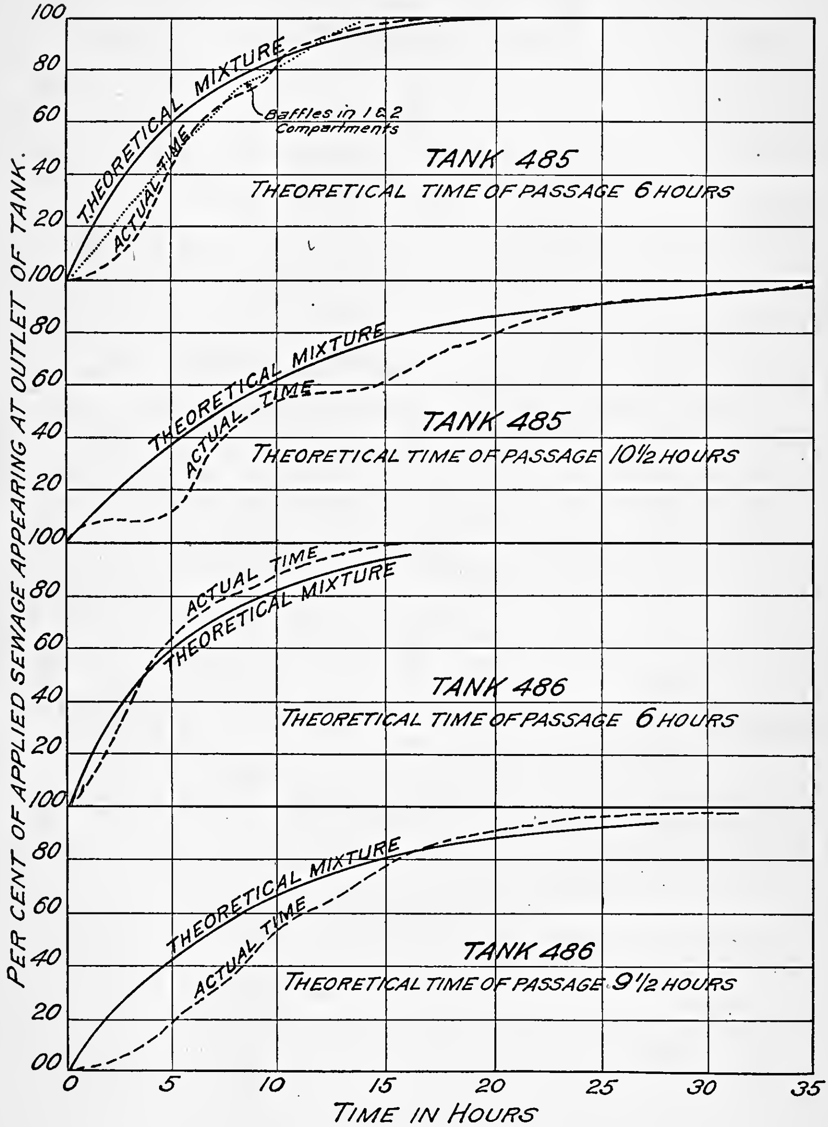
7½,	38	36	38	48	42	46
18½,	17	17	17	18	18	18

Run No. 4. — Four-hour Storage.

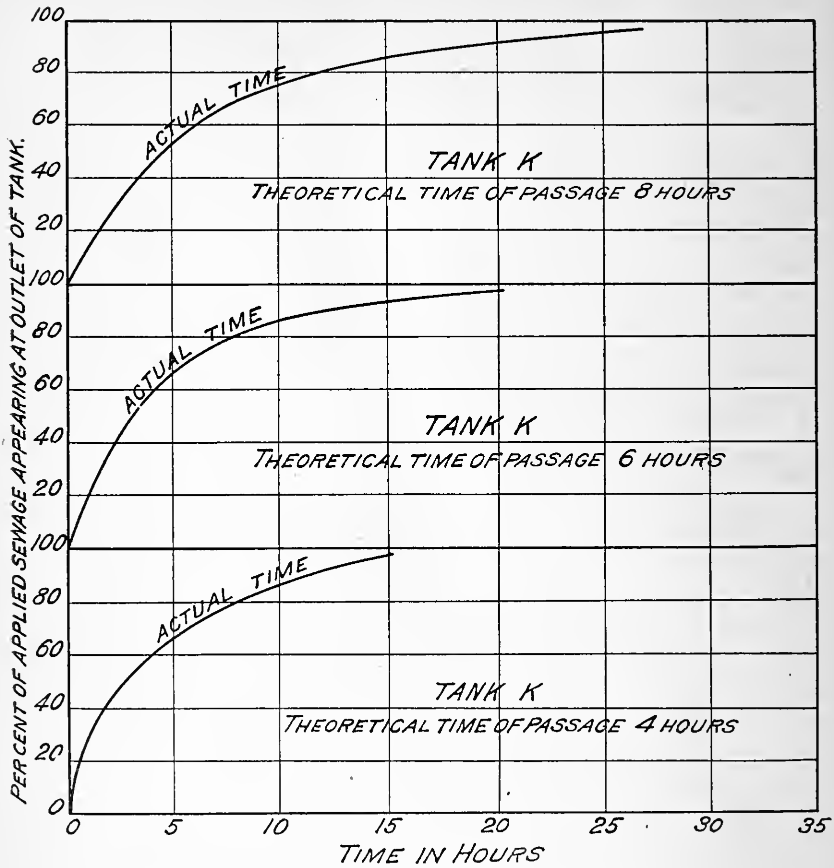
7,	12	7	15	31	19	55
19,	4	3	7	7	6	6

Run No. 5. — Six-hour Storage.

7,	16	17	16	36	17	36
24,	2	3	3	12	2	12
31,	1	1	1	1	1	1



PER CENT OF APPLIED SEWAGE APPEARING AT OUTLET OF TANK.
TIME IN HOURS
THEORETICAL MIXTURE
ACTUAL TIME
Baffles in 1 & 2 Compartments
TANK 485
THEORETICAL TIME OF PASSAGE 6 HOURS
THEORETICAL MIXTURE
ACTUAL TIME
TANK 485
THEORETICAL TIME OF PASSAGE 10½ HOURS
ACTUAL TIME
THEORETICAL MIXTURE
TANK 486
THEORETICAL TIME OF PASSAGE 6 HOURS
THEORETICAL MIXTURE
ACTUAL TIME
TANK 486
THEORETICAL TIME OF PASSAGE 9½ HOURS



Operation of Trickling Filters.

During 1917 thirteen trickling filters were operated at the station. Eleven of these filters received Lawrence sewage which had first been clarified by some method of treatment, and two filters were operated which received trade wastes.

Filter No. 135. — This filter was put into operation in 1899, and at the end of 1917 it had been in operation about eighteen years. The filter is 10 feet in depth and is constructed of pieces of broken stone having an average cubic content of .52 cubic centimeter, or, by the old methods of measurement, this stone is of such size that all will pass a 1-inch screen but be retained by a $\frac{1}{4}$-inch screen. It is a finer material than used in any of the other trickling filters at the station, and on that account has had a tendency at times to become clogged.

During all of the earlier years of operation this clogging could be removed by spading over the filter surface and allowing it to rest for a short time. During 1917, however, besides being out of operation for a week at a time, on two occasions the upper 3 inches of the stone were removed, washed and replaced. In spite of this treatment the quality of the effluent deteriorated during the year, and it is probable that the filter is gradually becoming clogged throughout its entire depth.

Filtration of the Aerated and Chemically Precipitated Sewage through Trickling Filters.

Filter No. 449. — This filter, started in 1913, contains 10 feet in depth of broken stone, each piece having an average volume of 5.06 cubic centimeters. All the stone will pass a 2-inch screen but all is retained by a one-inch screen. The filter has always been used for studies of the rate at which such a filter could be operated when receiving sewage from aerating or activated sludge tanks. During the year the average rate of operation was 6,375,000 gallons per acre daily. During the first three months of the year the effluent from slate aerating Tank No. 449 was applied, and during the remainder of the year the effluent from a similar tank, No. 486. The effluent from the filter was of very good appearance, low in organic matter for a trickling filter effluent, well nitrified, and 86 per cent. of all the samples of effluent were stable. It was put out of operation on October 1.

Filter No. 457. — This filter, similar in construction to Filter No. 449, was started in 1914, to study in connection with the latter, the comparative value of aeration and chemical precipitation as a preliminary treatment of sewage applied to trickling filters. The sewage applied to this filter was always clarified by the use of sulphate of alumina, and was practically the same chemically as the sewage applied to Filter No. 449. Notwithstanding this, Filter No. 449 could always be operated at a rate at least 50 per cent. greater, and produce an effluent equal to that of Filter No. 457; that is, preliminary treatment of the sewage in the aerating tank was to this extent superior to chemical precipitation.

Average Analyses.[1]

Sewage clarified in Slate Aerating Tank applied to Filter No. 449.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	Ammonia.			Kjeldahl Nitrogen.		Nitrogen as —		Oxygen consumed.	Per Cent. of Samples Stable.
	Free.	Albuminoid. Total.	Albuminoid. In Solution.	Total.	In Solution.	Nitrates.	Nitrites.		
-	2.30	.25	.19	.53	.38	.02	.0028	2.13	-
Chemically Precipitated Sewage applied to Filter No. 457.									
-	2.35	.24	.16	.59	.39	-	-	1.78	-
Effluent from Filter No. 449.									
8,120,000	1.67	.22	.14	.46	-	.72	.0105	1.65	92
Effluent from Filter No. 457.									
5,260,000	1.78	.23	.11	.46	-	.54	.0066	1.33	94

The Depth of Filtering Material and Trickling Filter Efficiency.

It was shown in the last report that trickling filters of a considerable depth are much more economical and efficient than shallow filters, and that this efficiency is due to two reasons: (1) to the fact that the sewage is relatively a much longer time in passing through the deeper filters, and (2) to the progressive mixture of the applied and the held sewage in these deep filters. The results given in that report were derived from the operation of two series of four filters each, namely, Filters Nos. 452 to 455, inclusive, put into operation in May, 1913, and Filters Nos. 472 to 475, inclusive, started in 1915. In each series the depth of the filters is 4, 6, 8 and 10 feet, respectively. The broken stone in the first series is of such size that all the pieces will pass a $1\frac{1}{2}$-inch screen but be retained by a $\frac{3}{4}$-inch screen. In the second series the broken stone is of much larger grade, the average volume of the pieces ranging from 25.2 to 29.4 cubic centimeters.[2] It was intended during this year to maintain the rates of all these filters at such a

[1] Four years.

[2] See report of Lawrence Experiment Station for 1915, p. 403.

point that the average nitrate content in their effluents would be from .75 to 1.0 part nitrogen in 100,000 parts, as experience had shown that with the Lawrence sewage now used this amount of nitrification invariably insured an effluent of a fair degree of stability. As a further check on the comparative degree of purification, the amount of oxygen absorbed on incubating samples of effluent for twenty-four hours at 70° F., in closed bottles, was determined at least once each month, and the results are shown in the following table. On incubation part of the oxygen absorbed or exhausted by the oxidation of the organic matter present is taken from the dissolved oxygen and part from the nitrates and nitrites. It was assumed in making these calculations that three-fourths of the nitrite oxygen and five-sixths of the nitrate oxygen were available for this oxidation.

Average Oxygen absorbed by Effluents from Filters Nos. 452 to 455, inclusive, and from Filters Nos. 472 to 475, inclusive.

[Parts in 100,000.]

Effluent from —	Oxygen absorbed from —		Total Oxygen absorbed.	
	Dissolved Oxygen.	Nitrates.	1917.	Average since Beginning of Operation of Filter.
Filter No. 452,	.42	3.15	3.15	1.88
Filter No. 453,	.46	2.97	3.43	1.84
Filter No. 454,	.49	2.24	2.73	1.45
Filter No. 455,	.53	2.43	2.96	1.66
Filter No. 472,	.47	2.20	2.67	2.14
Filter No. 473,	.43	2.17	2.65	2.21
Filter No. 474,	.43	2.17	2.60	2.09
Filter No. 475,	.50	1.92	2.42	2.07

It is probable that the comparative efficiency of these filters can best be shown by the number of gallons of sewage filtered for each foot in depth of material in the filter, and the following table gives these results for 1917 and the entire period of operation of the filters, together with stability results for the same time. The filters have not always been operated at the intended rates, due to unavoidable causes, and the effluents have not always been of equal quality, but the results are closely approximate. The rate at which Filter No. 473 was operated was evidently higher than it should have been, as shown by the low degree of stability of its effluent.

Filter Number.	Depth (Feet).	Gallons filtered per Acre Daily per Foot of Filter Depth.		Per Cent. of Samples Stable.	
		1917.	Since Beginning of Operation of Filter.	1917.	Since Beginning of Operation of Filter.
452,	4	72,000	95,000	84	85
453,	6	130,000	117,000	74	91
454,	8	175,000	196,000	89	96
455,	10	325,000	356,000	68	82
472,	4	48,000	83,000	68	82
473,	6	120,000	114,000	48	70
474,	8	89,000	118,000	74	80
475,	10	176,000	152,000	79	87

It is evident from this table that the greater efficiency of deep filters is somewhat more pronounced with material as fine as that in series Nos. 452 to 455, inclusive, than when the filters are constructed of material as coarse as that used in Filters Nos. 472 to 475, inclusive, and that, for the maintenance of high rates with a good degree of purification, the material in the first series of filters is more desirable than that used in the construction of the second series. Even with the material used in Filters Nos. 472 to 475, inclusive, however, a filter 10 feet deep can be operated at a rate per foot approximately twice that of a filter 4 feet in depth, or, as shown by the average rates of filtration given in the preceding table, the actual rate in gallons per acre daily of a 10-foot filter can, even with this coarse material, be from two and one-half times as great as that of a 6-foot filter, while with a finer material, as in series Nos. 452 to 455, inclusive, the rate of the 10-foot filter can be at least four times as great as that of a 6-foot filter, and with equal purification results.

Average Analyses.

Effluent from Filter No. 452 (4 Feet in Depth).

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	Turbidity.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. In Solution.	Kjeldahl Nitrogen.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
287,000	3.0	.580	.372	.264	.72	3.50	1.30	.0250	2.86	5.5	620,000
Effluent from Filter No. 453 (6 Feet in Depth).											
780,000	3.0	.600	.341	.217	.69	3.47	0.91	.0173	2.52	5.8	480,000
Effluent from Filter No. 454 (8 Feet in Depth).											
1,400,000	4.1	.634	.354	.242	.73	3.37	1.03	.0133	2.47	5.0	740,000
Effluent from Filter No. 455 (10 Feet in Depth).											
3,250,000	4.0	.558	.383	.234	.75	3.42	0.87	.0262	2.58	5.3	250,000
Effluent from Filter No. 472 (4 Feet in Depth).											
190,000	3.8	.485	.304	.222	.64	3.41	0.73	.0167	2.27	6.0	950,000
Effluent from Filter No. 473 (6 Feet in Depth).											
720,000	4.3	.863	.317	.229	.67	3.40	0.73	.0258	2.45	6.7	1,380,000
Effluent from Filter No. 474 (8 Feet in Depth).											
710,000	3.8	.696	.341	.231	.66	3.41	0.71	.0313	2.33	5.9	560,000
Effluent from Filter No. 475 (10 Feet in Depth).											
1,755,000	4.0	.707	.390	.241	.79	3.30	0.73	.0390	2.68	5.7	640,000

Average Analyses.

Effluent from Filter No. 135.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as —		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
				Albuminoid.								
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.			
1,731,000	3.8	1.3	.70	.4085	.2288	.83	3.41	.84	.0243	3.08	5.7	210,000

Operation of Contact Filters.

Contact filters at the station are operated largely to study the length of life of such filters and to illustrate to visitors the construction and method of operation of this type.

Four such filters were in operation during the year. Filter No. 175, put into operation in 1901, — sixteen years ago, — is constructed of coke of such size that all the pieces will pass a 1-inch screen, 75 per cent. a $\frac{1}{2}$-inch screen, and practically none a $\frac{1}{4}$-inch screen. At the end of 1911 all the material was removed, washed and replaced. Up to the beginning of this year this filter has always received sewage that has been strained through coke or coal. Since then it has received settled station sewage. It is flooded once daily and stands full two hours before draining, and is allowed to rest every sixth week. Eighty-four per cent. of the samples of the effluent collected during the year were stable, and the loss of open space at the end of the year was 43 per cent., an increase of 13 per cent. during 1917.

Filter No. 425 was started in January, 1911, and contains 33 inches in depth of clinker having a diameter between $\frac{1}{4}$ and $1\frac{1}{4}$ inches. It is filled twice daily and allowed to stand one hour before draining. The loss of open space at the end of the year was 52 per cent., an increase of 8 per cent. for the year.

Double Contact Filtration.

Filter No. 443, containing 21 inches in depth of broken stone pebbles all of which will pass a $\frac{1}{2}$-inch screen, 43 per cent. a $\frac{1}{4}$-inch screen, and practically none a $\frac{1}{8}$-inch screen, was started in April, 1912, and has been operated twice daily as a secondary contact filter with Filter No. 425. Both are rested every sixth week. During the year 63 per

cent. of the samples from the primary filter, and 89 per cent. of the samples from the secondary filter, were stable. The loss of open space at the end of the year was 40 per cent., an increase of 4 per cent.

Contact Filtration of Sewage clarified by Aeration.

Filter No. 456, containing 3 feet in depth of clinker passing a 1-inch screen and held back by a ½-inch screen, was started on Jan. 1, 1914, to study the operation of contact filters with sewage clarified in slate aeration tanks. It was flooded three times daily to October 1, and the loss of open space was 33 per cent., the same as at the beginning of the year.

After an equal period of operation, Filter No. 426, described in previous reports, which was also filled three times daily with settled station sewage but allowed to rest every sixth week, and hence operated at a lower rate, lost 63 per cent. of its open space. Ninety-three per cent. of the samples from Filter No. 456 were stable, and the effluent was of better quality than that from Filter No. 426.

Average Analyses.

Effluent from Filter No. 175.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	Turbidity.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. In Solution.	Kjeldahl Nitrogen.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
394,200	4.0	.4714	.2556	.2021	.52	3.19	.60	.0190	2.32	6.2	730,000

Effluent from Filter No. 425.

432,900	4.7	.4570	.3105	.2233	.65	3.47	.76	.0290	2.48	6.7	550,000

Effluent from Filter No. 443.

433,000	3.2	.2960	.2380	.1873	.52	3.47	1.06	.0205	2.11	5.6	610,000

Effluent from Filter No. 456.

921,000	2.5	.6355	.2507	.1724	.54	3.20	0.59	.0144	1.86	8.9	450,000

Commercial Aspects of Sewage Treatment.

For several years considerable work has been carried on at Lawrence and elsewhere in regard to the varying amount of sludge that could be saved by the activated sludge process and in settling tanks receiving the effluents from trickling filters, this last work being especially studied at the experiment station. Numerous analyses have been made of the sludge from the activated sludge process in different parts of the country, such as at the plant in Milwaukee, at the stock-yards in Chicago, at Lawrence and elsewhere, and the character and value of the sludge from trickling filters have been especially studied at Lawrence. Of course the amount of sludge that can be saved from either process depends upon the amount of suspended matter in the sewage undergoing treatment and the degree of purification carried on. In trickling filter purification it depends also to some extent upon the coarseness of the filtering material used and the ease with which sludge, modified in its composition by passage through these filters, is loosened from the filtering material and collected. Certain trickling filters of coarse material at Lawrence have always contained in their effluents at least 70 per cent. of the matters in suspension in the applied sewage, and a very large percentage of this can be collected in settling basins. Averaging all the results that we have in regard to suspended matter found in the effluent from Filter No. 135, for instance, these results show that 76 per cent. of the suspended solid matters applied was found in the effluent. Similar figures from Filter No. 136 show that practically 100 per cent. of the matters in suspension in the applied sewage was found in the effluent. Probably both of these figures are slightly in error owing to the irregularity with which suspended matter accumulated in such filters is loosened and comes through them in their effluents.

Studies of other trickling filters at Lawrence show similar results, and it is evident that with coarse trickling filters operated in the manner followed at Lawrence, quite 70 per cent. of the applied suspended matter can be collected in proper settling basins. Analyses of the matters in suspension in the applied sewage and in the effluents from these filters have been made from time to time during the past seventeen years, and the average results are shown in the following table: —

Average Analysis of Sewage Sludge and Sediment from Filters Nos. 135 and 136, 1901 to 1917, inclusive.

Sewage.			Filter No. 135.			Filter No. 136.		
Per Cent. Nitrogen.	Per Cent. Fats.	Per Cent. Loss on Ignition.	Per Cent. Nitrogen.	Per Cent. Fats.	Per Cent. Loss on Ignition.	Per Cent. Nitrogen.	Per Cent. Fats.	Per Cent. Loss on Ignition.
3.04	17.9	57.5	2.19	3.21	44.6	2.02	2.52	42.6

Since 1912 a number of activated sludge tanks have been in operation at the Lawrence Experiment Station. The fairest and best data in regard to the operation of these tanks can be obtained from the results of the operation of Tank No. 485. This tank was started on April 10, 1917, and up to the end of the year it had received approximately 300,000 gallons of sewage. The suspended matters in the applied sewage amounted to 20.1 parts in 100,000, and in the effluent, 5.3 parts. These figures would show that there were apparently about 1,660 pounds of matters in suspension in each million gallons of effluent, hence 1,220 pounds of sludge per million gallons of sewage treated should have accumulated in this tank. The examinations and analyses showed that the actual amount was about 750 pounds per million gallons, the difference indicating to some extent irregularity in operation and collection of samples, but largely the destruction of organic matter in the tank by oxidation. This sludge contained on an average 3.8 per cent. of nitrogen.

Treatment of Sewage with SO_2 for the Collection of Sludge, etc.

During the year much work was carried on to ascertain the amount of fatty matters, nitrogen, etc., in the sewage entering Boston Harbor from the sewer outlets at Deer Island, Moon Island and Peddock's Island. A large number of samples were collected on different dates from these outlets for examination and experiment. These examinations and experiments were for the purpose of determining the total average volume of sludge and fatty matters settling out from the sewage in a few hours under normal conditions, and also the volume of sludge and fatty matters settling out when the sewage from each outlet was acidified by means of SO_2 gas. Eleven lots of sewage from the Peddock's Island and Deer Island outlet sewers, and nine lots from the Calf Pasture pumping station, were collected and sent to

the laboratory for analytical and experimental work. The samples from each outlet were collected in three portions, each representing one-third of a day's flow, — from midnight to 8 A.M., from 8 A.M. to 4 P.M., and from 4 P.M. to midnight.

A following table gives the average analysis of all samples of sewage from each outlet, together with analyses of the supernatant liquor after a period of sedimentation and of the supernatant liquor after treatment with SO_2 followed by sedimentation.

A second table gives the results of the experiments and determinations in regard to the fatty matters, nitrogen, etc., present after plain sedimentation and after treatment with SO_2 followed by sedimentation.

Average Analyses of Sewage entering Boston Harbor from July 17, 1917, to Sept. 27, 1917.

PEDDOCK'S ISLAND.

Raw Sewage.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Oxygen consumed.
	Albuminoid.					
Free.	Total.	In Solution.	Total.	In Solution.		
1.40	.33	.18	.68	.36	13.4	2.31
Supernatant Sewage after Sedimentation.						
1.22	.16	.11	.35	.22	-	1.54
Supernatant Sewage after Acidification and Sedimentation.						
1.33	.17	.11	.35	.22	-	-
DEER ISLAND. *Raw Sewage.*						
2.33	.82	.48	1.68	.89	301.0	8.73
Supernatant Sewage after Sedimentation.						
2.11	.56	.39	1.07	.73	-	6.22
Supernatant Sewage after Acidification and Sedimentation.						
2.09	.52	.39	1.00	.75	-	-

Average Analyses of Sewage entering Boston Harbor from July 17, 1917, to Sept. 27, 1917 — Concluded.

CALF PASTURE.

Raw Sewage.

[Parts in 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Oxygen consumed.
Free.	Albuminoid.					
	Total.	In Solution.	Total.	In Solution.		
1.80	.45	.20	0.97	.41	325.4	4.12
Supernatant Sewage after Sedimentation.						
1.91	.23	.14	0.49	.33	-	2.58
Supernatant Sewage after Acidification and Sedimentation.						
1.78	.24	.16	0.49	.33	-	-

Average Amount of Sludge and Fats obtained from Sewage entering Boston Harbor after approximately Eighteen Hours' Sedimentation, with and without Treatment with SO_2.

	Peddock's Island.	Deer Island.	Calf Pasture.
Pounds of SO_2 used per million gallons of sewage,	818	1,513	1,189
Pounds of dry sludge obtained per million gallons of sewage (acidified).	959	1,939	1,427
Pounds of dry sludge obtained per million gallons of sewage (unacidified).	762	1,709	1,208
Pounds of fats obtained per million gallons of sewage (acidified).	226	541	342
Pounds of fats obtained per million gallons of sewage (unacidified).	183	373	269
Increase in pounds of sludge obtained due to SO_2,	197	230	219
Increase in pounds of fats obtained due to SO_2,	43	168	73
Per cent. of nitrogen in sludge (acidified),	3.38	3.45	2.83
Per cent. of nitrogen in sludge (unacidified),	3.10	3.56	3.18
Per cent. of fats in sludge (acidified),	27.30	19.40	26.30
Per cent. of fats in sludge (unacidified),	26.30	24.60	24.30

A study of this table shows that the amount of fatty matters found varied from an average of 226 pounds per million gallons in the sewage

from Peddock's Island outlet to 342 pounds in the sewage from the Calf Pasture pumping station and 541 pounds in the strongest sewage, namely, that from the north metropolitan system entering the harbor near Deer Island light; and the nitrogen present was found to be 27, 34 and 52 pounds, respectively, in these three sewages. These were the amounts of these materials found when the sewage was acidified with SO_2 to a degree in excess of that actually required for the reactions desired.

The results summarized here are those obtained from over 250 chemical analyses and of much experimental work during a period of three months. As shown by this work, assuming that our results were average results, as seems to be true, the strongest sewage entering Boston Harbor contains not over 550 pounds of recoverable fatty matters and 52 pounds of nitrogen in each 1,000,000 gallons of sewage. Potash results are not given in the table, as many examinations have shown that it is present in only negligible quantities and cannot be recovered.

In 1910, 1911 and 1912 the State Department of Health made, by direction of the Legislature, extensive studies of the sanitary condition of the Merrimack River, and this study included many measurements of the volume of waste wool-liquor produced at Lawrence and entering this river, and a large amount of analytical work to determine the character of these wastes, especially as to the amounts of grease, potash and nitrogen present. The results of these studies were given in a report (House, No. 2050) made in 1913, entitled "Report of the State Board of Health upon the Sanitary Condition of the Merrimack River."

In this report it was shown that the average volume of output from the first and second bowls of the wool-scouring machines at all of the wool-scouring plants of the city amounted to 211,000 gallons a day, and that this volume of liquor contained, on an average, 29,000 pounds of fatty matters, 14,000 pounds of potash and 2,200 pounds of nitrogen; that is, each gallon of liquor contained .14 pound of fats, .07 pound of potash and .01 pound of nitrogen. Notwithstanding the large amount of valuable materials found in this liquor, however, the Department was not able at that time to persuade the manufacturing concerns of the city to erect a suitable plant or plants for the recovery of these matters.

At the present time, as there is only a small available supply of potash and grease in the country on account of the war, and because of the greatly enhanced price of each, two companies from outside the city are taking the richest wastes from nearly all the mill plants

in Lawrence, and we are informed are making some profit. Plants for the recovery of grease from wool waste are also in successful operation at three or four other places in Massachusetts.

One of the companies at Lawrence recovers both fatty matters and potash, while the plants of the other company are constructed to recover fatty matters only, these fatty matters being worked up into lanolin, etc. These various recovery plants treat approximately 2,000,000 gallons of the richest wastes each month, or about 80,000 gallons a day, taking, however, only the wastes from the first bowl of each wool-scouring plant.

Intermittent Sand Filters operated with Untreated Sewage.

Filters Nos. 1, 4 and 9A.

Each of these three sand filters is $\frac{1}{200}$ of an acre in area, and at the end of the year Filters Nos. 1 and 4 had been operated continuously for nearly thirty years, and Filter No. 9A had been operated twenty-seven years. These filters are the oldest well-operated sewage filters at the station and probably in this country, and are kept in operation to demonstrate the permanency of such filters when properly cared for. Regular station sewage without preliminary clarification has always been applied to them, and for many years it has been the practice to apply only as much sewage to each filter as can be purified without increasing the load of organic matter stored within the filter. Since 1893, a period of about twenty-four years, all of these filters have been operated without sand removal.

The depth of the filter and grade of sand of which each filter is constructed, the date when first put into operation, the total volume of sewage treated upon each filter since it was started, and the volume of sewage applied daily during the year are shown in the following table:

Filter Number.	Depth (Feet).	Effective Size of Sand (Millimeter).	Date first operated.	Actual Volume of Sewage applied since Start (Gallons).	Volume of Sewage applied daily during 1917 (Gallons per Acre).
1,	5	.48	Jan. 10, 1888	2,962,070	51,600
4,	5	.04	Dec. 19, 1887	1,026,799	23,500
9A,	5	.17	Nov. 18, 1890	2,450,093	52,300

For a number of years the surfaces of Filters Nos. 1 and 9A have been leveled during the summer, but have been trenched and ridged

during the winter. The surface of Filter No. 4 is arranged in circular trenches which are filled with a coarser sand than that of which the filter is constructed. These trenches are about 14 inches wide and 1 foot deep, and are filled with sand of an effective size of 0.48 millimeter, the surface of the sand in the trenches being below the surface of the remainder of the filter. The sewage is applied to these trenches throughout the year, grass being permitted to grow on the ridges. During the year the surface of the filters was dug over once to a depth of from 8 to 10 inches, and Filters Nos. 1, 4 and 9A were raked to a depth of 2 inches on sixteen, nine and ten different occasions, respectively. Board coverings were put over the trenches on December 13 and removed on April 11.

An examination of the sands in Filters Nos. 1 and 9A is made about the 1st of July each year. As has been previously stated, the greater part of the stored organic matter is in the first foot of sand. A following table gives results of analyses during the past ten years.

The average analyses of the effluents from these filters during the year are shown in the following table: —

Average Analyses.

Effluent from Filter No. 1.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature (Degrees F.).		Ammonia.		Chlorine.	Nitrogen as —		Oxygen consumed.	Alkalinity.
	Sewage.	Effluent.	Free.	Albuminoid.		Nitrates.	Nitrites.		
51,600	56	55	.4294	.0812	3.96	1.30	.0034	.88	.31

Effluent from Filter No. 4.

23,500	57	50	.0718	.0249	3.41	1.16	.0079	.35	.24

Effluent from Filter No. 9A.

52,300	58	52	.3103	.0525	3.79	1.28	.0004	.72	.40

Sand Analyses.

Albuminoid Ammonia in First Foot of Sand in Filters Nos. 1 and 9A.

[Parts in 100,000.]

Year.	Filter No. 1.	Filter No. 9A.
1908,	57.9	60.2
1909,	52.7	69.3
1910,	66.1	56.5
1911,	45.6	65.1
1912,	74.0	83.9
1913,	77.3	74.8
1914,	95.2	76.0
1915,	74.9	81.1
1916,	80.8	70.0
1917,	83.0	79.2

Study of Varying Rates with Equal Organic Matter.

Intermittent Sand Filters Nos. 429, 430 and 432.

These three filters were first put into operation on Feb. 11, 1911, to study the results obtained from a series of filters receiving sewages of different strength, but operated at such rates in gallons per acre daily that the amount of organic matter applied to each was practically the same. Each of these filters is $\frac{1}{20000}$ of an acre in area, and is constructed of 5 feet in depth of sand of an effective size of 0.25 millimeter over the usual underdrains. Regular station sewage has been applied to Filter No. 429 at a rate of about 80,000 gallons per acre daily. Filter No. 430 received settled sewage, and Filter No. 432 received sewage clarified by precipitation with aluminum sulphate. The volume of sewage applied to each was varied from time to time so the amount of organic matter applied should equal that applied to Filter No. 429. As these filters were discontinued on November 30, after nearly seven years of operation, a summary of the results for this entire period can be given. Kjeldahl nitrogen has been used as a measure of the organic matter in computing the rates of the filters receiving clarified sewage, and these rates have been fluctuated from time to time as the nitrogen of the different sewages has varied.

The amount of organic nitrogen, expressed in pounds per acre, applied to Filters Nos. 429 and 432 during this time, was 15,281 pounds each, while Filter No. 430 received about 200 pounds more.

The average organic matter expressed as albuminoid ammonia in the entire depth of sand in each filter at the end of each year is given in a following table. It will be seen that practically the same amount of organic matter was stored in each, and that an equilibrium was reached between the amount deposited in the sand and the amount oxidized, as with Filters Nos. 1 and 9A.

Of the total organic matter applied to these filters, measured by determinations of solids, Filter No. 429 received 46 per cent. as suspended matter; Filter No. 430, 25 per cent.; and Filter No. 432, 18 per cent. The effluents from these filters have been of practically the same degree of purification. The nitrates in the effluent from Filter No. 429 were higher because the applied sewage contained more free ammonia. All three filters received the same surface treatment, being raked over twenty-six times and dug over twice. They also received sewages covering a fair range of strength and degree of clarification, and from the results of their operation it must be concluded that within reasonable limits a given amount of organic matter in sewage can be equally wel' purified by sand filters, whether the sewage is unclarified, clarified by sedimentation or chemically precipitated. If a rate much higher than that of Filter No. 432, 142,000 gallons per acre daily, is attempted, the filter will tend to lose its intermittent character, which is essential to sand filtration of sewage, and approach continuous operation, with establishment of anærobic conditions within the filter.

Average Analyses, 1911 to 1917, inclusive.

Regular Sewage applied to Filter No. 429.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	Color.	Ammonia.		Kjeldahl Nitrogen.		Chlorine.	Nitrogen as —		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Free.	Total Albuminoid.	Total.	In Solution.		Nitrates.	Nitrites.		
-	-	3.3900	.5300	1.09	.68	9.71	-	-	3.76	2,200,000

Settled Sewage applied to Filter No. 430.

-	-	2.8000	.3700	0.75	.54	9.80	-	-	2.77	1,673,000

Chemically precipitated Sewage applied to Filter No. 432.

-	-	3.0300	.3000	0.62	.42	8.90	-	-	2.20	737,000

Average Analyses, 1911 to 1917, inclusive — Concluded.

Effluent from Filter No. 429.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre Daily.	Color.	Ammonia.		Kjeldahl Nitrogen.		Chlorine.	Nitrogen as —		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Free.	Total Albuminoid.	Total.	In Solution.		Nitrates.	Nitrites.		
77,600	.08	0.1855	.0224	–	–	9.20	3.48	.0018	0.24	1,130
Effluent from Filter No. 430.										
120,600	.11	0.1443	.0305	–	–	9.70	2.83	.0007	0.30	10,250
Effluent from Filter No. 432.										
142,900	.08	0.3995	.0308	–	–	8.80	2.85	.0021	0.27	2,860

Average Albuminoid Ammonia in Sands at End of Year.

[Parts in 100,000.]

Year.	Filter No. 429.	Filter No. 430.	Filter No. 432.
1911,	7.8	8.2	7.3
1912,	17.3	14.3	16.5
1913,	19.6	19.6	16.6
1914,	20.6	19.6	19.4
1915,	26.3	20.7	26.0
1916,	22.3	24.4	22.5
1917,	23.7	23.2	21.7

Wastes from the Lewis Manufacturing Company, Walpole.

These wastes result from the washing and bleaching of cloth, and experiments in regard to their purification were started on June 8 and continued until September 15. In all, fifteen lots representing average samples of from twenty minutes' to one hour's flow of waste were received, and analyses were made of each sample and a mixture made of each lot for treatment and filtration.

Eleven lots contained free chlorine, one running as high as 68 parts in 100,000. Four of these were also acid, the maximum acidity being 59 parts in 100,000. Obviously, these wastes could not be successfully filtered until the free chlorine and acidity were removed. The most practical way of doing this seemed to be to allow the wastes to stand in contact with scrap iron. An average of three and one-half hours' contact neutralized the acid and removed the free chlorine. An average of 6.2 parts, or 525 pounds per million gallons of iron, was dissolved and soon largely precipitated out, aiding in the clarification. On one or two occasions the wastes contained some free oil, and this was removed with the iron precipitate. This treatment was of little use on lots of waste which contained no free chlorine or were excessively alkaline.

The treated wastes after settling over night were applied to Filter No. 491, which was $3\frac{1}{2}$ feet in depth and constructed of sand of an effective size of 0.25 millimeter. The average rate of operation was 226,000 gallons per acre daily, and with the exception of two weeks, when waste containing a considerable proportion of digester liquor was applied, the effluent was clear, with an average color of .46. At the end of the experiment the surface sand showed signs of clogging.

It is evident that for successful filtration the strong, alkaline, digester liquors must be disposed of separately, or be evenly diluted with the other wastes. The average analyses of the raw, treated and filtered wastes are shown in the following table:

Average Analyses.

Raw Wastes.

[Parts in 100,000.]

Ammonia.			Chlorine.	Free Chlorine.	Nitrogen as —		Oxygen consumed.	Iron.	Alkalinity.
Free.	Albuminoid.								
	Total.	In Solution.			Nitrates.	Nitrites.			
.14	.48	.38	33.8	13.3	-	-	8.92	-	25.0
Waste Liquor after Contact with Iron and Settling, applied to Filter No. 491.									
.13	.33	.31	-	0.0	-	-	5.60	6.2	31.5
Effluent from Filter No. 491.									
.12	.21	-	-	-	.03	.0030	2.26	-	26.7

Average Solids.

Raw Wastes.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
265.3	76.1	189.2	233.6	67.5	166.1	31.7	8.6	23.1
Waste Liquor applied to Filter No. 491.								
232.8	46.4	186.4	212.7	42.1	170.6	20.1	4.3	15.8

Wastes from the Winchester Manufacturing Company.

This plant is engaged in the manufacture of glue and gelatin. The resulting wastes consist of condenser water and cooling water. The cooling water coming in contact with the glue dissolves a certain amount of nitrogenous bodies which make a very persistent froth when the water is agitated. There are falls at one point in the stream into which these wastes flow, and the froth or foam produced there created a nuisance.

Ten grains of alum and 5 grains of soda ash per gallon added to the cooling water formed a precipitate which settled slowly, giving a supernatant liquor which had lost its frothing properties. A sand filter operated at a rate of 200,000 gallons per acre daily, and a trickling filter 7 feet in depth and operated at a rate of 1,000,000 gallons per acre daily, gave a well-nitrified effluent free from frothing qualities. These filters were operated about two weeks when the experiments were discontinued, a connection from the plant having been made with a sewer and the wastes disposed of in this way.

Wastes from the Natick Paper Box Company.

This mill is engaged in working up waste newspaper and magazine paper. The waste liquors, amounting to approximately 60,000 gallons daily, are passed through two fine screen save-alls, but the final waste still contains a large amount of flocculent sediment and is very turbid. The local conditions were such that chemical precipitation seemed preferable to filtration, and experiments with milk of lime, and aluminum sulphate with a small amount of lime, were tried at the station. The supernatant liquor from the treatment with lime and aluminum sulphate was perfectly clear.

The average analyses for three lots of wastes follow: —

Average Analyses.

Raw Wastes.

[Parts in 100,000.]

Ammonia.			Oxygen consumed.		Chlorine.	Alkalinity.
Free.	Albuminoid.					
	Total.	In Solution.	Total.	In Solution.		
.10	.40	.27	21.0	9.67	6.0	6.7
Waste Liquor precipitated with 2,500 Pounds of Aluminum Sulphate and 660 Pounds of Lime per Million Gallons.						
.14	.15	–	8.0	–	–	5.5
Waste Liquor precipitated with 9,000 Pounds of Lime per Million Gallons.						
.07	.20	–	7.8	–	–	67.5

Average Solids.

Raw Wastes.

[Parts in 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
128.3	87.2	41.1	72.7	35.1	37.6	55.6	52.1	3.5

Effect of Spent Iron Pickling Liquors on Sewers.

In this work a sample of spent sulphuric acid liquor was found to contain 1.95 per cent. free acid, and a sample of partially spent hydrofluoric acid liquor, so called, 2.45 per cent. free acid, probably all sulphuric acid, however, as it did not etch the bottle containing it. Portions of the two liquors were allowed to stand over night in contact with pieces of cast iron. Iron was dissolved at the rate of 1.07 ounces and 1.42 ounces per gallon, respectively, by the two wastes. Next, small concrete blocks were placed in the acid liquors. At first the action was quite energetic, carbon dioxide being evolved, but after twenty-four hours this action had nearly ceased, the surface of the blocks being then, of course, largely composed of sand, with the in-

terstitial spaces filled with calcium sulphate. When the blocks were placed in running water the calcium sulphate was dissolved, leaving the blocks ready for another attack by the acid, and by alternately applying acid and water the blocks were completely disintegrated. As similar conditions would prevail in sewers, it is evident that such wastes should not come in contact with concrete or iron. The action of such liquors on vitrified pipe or brick was much slower, and after several months' contact with these wastes there was practically no evidence of injurious action.

Removal of Color from Water.

Experiments in regard to the removal of color from water were begun in December, 1916, and are still in progress. The work during 1917 can be summarized as follows: The first experiments were along lines similar to the activated sludge process in sewage purification; that is, sludge from the preliminary settling tank of a mechanical water filter which was operated with the use of aluminum sulphate as a precipitant was added to water, and this water was aerated for various periods, the time of aeration varying from several hours up to several weeks. At the end of each period of aeration the sludge was allowed to precipitate and the water withdrawn, fresh water being added to the sludge and this sludge used over and over again. This treatment, however, caused considerable of the sludge to pass into a colloidal form that would not settle; in other words, it became what is known as a reversible colloid. In order to clarify the water after this treatment small amounts of aluminum sulphate were added. This caused the colloidal matters to precipitate, but the final results, as far as color removal was concerned, showed no improvement on the removal of color by the addition of an equal amount of precipitant without aeration. Following this, efforts were made to decolorize water by aeration in contact with the gelatinous organic matter removed from a roughing water filter, but without any favorable results.

Ferric hydrate was next added to highly colored water, and periods of aeration tried, but the iron also had a tendency to go into colloidal form. Under similar conditions of operation, etc., milk of alumina gave good color removal. Owing to this, an experiment was started to determine whether a given amount of alum, in the form of milk of alumina or aluminum hydroxide, would, on being agitated and aerated with colored water, remove the color from as large a volume of water as when used in the usual way. It proved to be less efficient, however, in this aeration work, due to unavoidable loss of aluminum hydroxide in the supernatant liquid drawn out in each experiment.

The next experiment tried was the passing of water slowly upward through a 6-foot column of aluminum hydroxide in a 2-inch tube. Fair color removal ensued but, as in the previous experiment, aluminum hydroxide was lost. Next, silicon dioxide was precipitated on the sand in a small filter, and other sand was treated with hydrofluoric acid, sulphuric acid and sodium hydroxide. No increased color removal was obtained when water was filtered through any of the sands so treated. These results were, of course, anticipated.

Practically all New England sand contains a certain amount of iron which is very readily soluble in even dilute acid, and it has always been supposed, and, in fact, proved at the experiment station, that this iron, probably in the form of carbonate or hydroxide, has considerable efficiency in removing color from water. Hence, laboratory experiments, using as filters glass percolators about 2 inches in diameter and 10 inches long, were begun, the percolators being filled with sand which was treated in the following way: First, a dilute solution of neutral or slightly basic ferric sulphate was filtered through, basic ferric sulphate being precipitated. Sand treated in this way, when used in a filter at a rate of 5,000,000 gallons per acre daily, gave good color removal, but was efficient for only a few days. Next, finely divided calcium carbonate was mixed with sand at the rate of 13 tons per acre of filter surface, and a solution of ferric sulphate allowed to pass through the sand very slowly. Examinations showed that about 17.5 tons of ferric sulphate per acre of surface were precipitated. The sand treated in this way was then placed in a glass percolator, and the little filter thus constructed was operated at a rate of 5,000,000 gallons per acre daily. The amount of iron used would, at the rate of 2 grains per gallon, coagulate and remove a large part of the color in about 122,000,000 gallons of water. In the operation of the filter, color removal was good; that is, equal to more than 90 per cent. until 94,000,000 gallons per acre had been filtered, when the color increased suddenly to such an extent that only 50 per cent. was being removed, this percentage removal lasting while 50,000,000 gallons per acre more were filtered. To renew the filter, soda ash in an amount equal to 6.5 tons an acre was dissolved in the water passed into the sand, and the filter allowed to stand full twenty-four hours. By this treatment 37 per cent. of the color removed from the water applied to the filter, and which had accumulated in the filter, was extracted; of the organic matter removed, 55 per cent. was extracted and of the organic nitrogen, about 40 per cent. Following this treatment the filter was again operated with colored water, and through a considerable period the color removal was about 68 per cent.

The laboratory experiments were now discontinued, and on May 3 a filter (No. 487), 23.5 inches in diameter and containing 2 feet in depth of sand of an effective size of .34 millimeter, was treated with ferric sulphate at the rate of 43,500 pounds per acre. The method of applying the iron was as follows: The filter was thoroughly drained and the ferric sulphate in dilute solution was applied, followed by the addition of an equivalent amount of sodium hydroxide, also diluted. The filter was allowed to drain after the application of each chemical, and the iron and caustic drainings alternately applied to the filter until all the iron used had been precipitated in the sand as ferric hydrate.

A second filter (No. 488) was treated in the same way with iron, but magnesium oxide was used to furnish the alkali instead of sodium hydroxide. The amount of iron precipitated in the sand did not seem to affect the loss of head appreciably, when the filters were operated at a rate of 5,000,000 gallons per acre daily. The volume of water filtered by these filters from May 23 to November 30, inclusive, was about 1,080,000,000 gallons per acre. Deducting, however, the period after treatments, when the effluent was allowed to run to waste, the total effective amount of effluent was about 1,040,000,000 gallons per acre. The iron precipitated in the filters in the beginning of the period of experiment was equivalent to .3 grain per gallon for the 1,040,000,000 gallons, and the caustic soda equivalent to .2 grain per gallon for the 1,040,000,000 gallons. By the usual coagulation method the amount of iron necessary to remove color from such water as was applied to these filters is from 1.5 to 2 grains per gallon. Filter No. 487 removed during this period of operation about 55 per cent. of the coloring matter in the water applied, and Filter No. 488 about 60 per cent.

One of the great advantages of removing color by the method described, rather than by the application of aluminum sulphate, etc., directly to the water, is that the effluent from the filters contains no more carbon dioxide than the water applied, whereas this carbon dioxide is very materially increased by the usual coagulating methods. There is no increase in soap hardness.

Applied Water.

[Parts in 100,000.]

Color.	Ammonia.			Nitrogen as —		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
	Free.	Albuminoid.							
		Total.	In Solution.	Nitrates.	Nitrites.				
.41	.0166	.0189	.0151	.019	.0011	.48	.0518	1.2	1.3
Effluent from Filter No. 487.									
.18	.0053	.0085	-	.024	.0009	.16	.0080	1.2	1.2
Effluent from Filter No. 488.									
.14	.0038	.0073	-	.024	.0017	.15	.0044	1.3	1.2

During the operation of these filters it was necessary on three occasions to treat the sand with caustic solution of soda in order to remove the organic matter which accumulated in the filters. This treatment was efficient in restoring the filters to such a condition that their normal work could be continued. It was, of course, necessary to drain and wash out the filters after each treatment with alkali, this meaning at each time of applying caustic the loss of two days' operation. Experiments along this line are being continued with the use of precipitated aluminum in the filters instead of iron, and with more or ess promising results.

The following table shows the color of the effluents from other filters in operation at Lawrence, including the city filter and mechanical filters operated with aluminum and ferric sulphate. The colors as given of the effluent from the city filter and Filters Nos. 417, 419 and 343 are those obtained during the same period of operation as the filters just described.

[Parts in 100,000.]

	Color.
Merrimack River at intake of city filters,	.43
Effluent from old city filter,	.29
Effluent from new city filter,	.29
Effluent from Filter No. 417,	.24
Effluent from Filter No. 419,	.29
Tap at experiment station,	.30
Effluent from Filter No. 343,[1]	.20
Effluent from mechanical filter using alum,	.15
Effluent from mechanical filter using ferric sulphate,	.14

[1] Tap water refiltered.

The Use of Ammonia with Bleach in the Treatment of Water (Chloramine).

The first proposal to use ammonia with hypochlorite in the sterilization of water seems to have been made by Race (Surveyor, London, Eng., March 3, 1916). He was led to do this by some work of Rideal several years earlier, which indicated that the chlorine of bleach formed substitution products with ammonia and with proteid bodies which were of a higher germicidal value than the bleach itself.

It is assumed that the compound formed with ammonia is NH_2Cl and to this body the name "chloramine" has been applied. No reference is made to this compound in the older textbooks, and current literature has very little to say about it. Raschig [1] states that it is formed rapidly and nearly quantitatively at low temperatures in dilute mixtures of ammonia and sodium hypochlorite. Bray, Dowell and Noyes [2] apparently accept this statement. Dakin [3] and others have given the name "chloramine" to certain aromatic compounds, containing the NCl linkage, and have shown that nearly all compounds containing the NCl group are efficient germicides.

It is generally agreed that aside from the direct oxidizing action of hypochlorites there is a secondary action; that is, a combination with proteins or ammonia to form chloramine. Race found in an experimental plant at Ottawa that the amount of available chlorine required for disinfection of water could be reduced from about 1 part per million to about .25 part if .13 part of free ammonia was added.

The results of some preliminary laboratory experiments made along the same lines at the Lawrence Experiment Station are shown in the following table. The experiments were made in bottles using Merrimack River water. The designated amounts of bleach or the mixture of bleach and ammonia were added and tests made after one and twenty-four hours' contact with the chemicals. The results given in the table show the increased effect of a given amount of bleach when half as much ammonium hydrate is added. Not enough data are as yet available to show how much the bleach may be reduced when ammonia is added and still give the same results as a given amount of bleach alone. The few results obtained indicate that it cannot be reduced as much as one-half. In experiments made by us on the treatment of sewage, the addition of ammonia had little effect. This was to be expected as sewage contains from five to ten times as much "free ammonia" as would be added with the bleach.

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[1] Chem. Ztg., 31, 926.
[2] J. Am. Chem. Soc., May, 1917, 905.
[3] Proc. Roy. Soc., London, 89, 232–251, and Brit. Med. Jour., 1916, 1, 160–162.

Table showing the Effect of using Ammonia with Hypochlorite in the Treatment of Merrimack River Water.

Available Chlorine (Parts per Million).	Ammonia (Parts per Million).	Time of Contact (Hours).	Bacteria per Cubic Centimeter.			B. Coli in —			
			4 days 20° C.	24 hours, 37° C.		.01 Cubic Centimeter.	.10 Cubic Centimeter.	1.0 Cubic Centimeter.	10 Cubic Centimeters.
				Total.	Red.				
Control,	.00	1	1,400	360	50	+	+	+	+
1.00	.00	1	22	14	1	0	0	0	0
1.00,	.50	1	7	4	0	0	0	0	0
Control,	.00	24	2,000	100	40	0	+	+	+
1.00,	.00	24	75	80	60	0	0	0	0
1.00,	.50	24	0	0	0	0	0	0	0
Control,	.00	1	15,000	500	230	+	+	+	+
1.00,	.00	1	14	10	2	0	0	0	0
1.00,	.50	1	8	12	0	0	0	0	0
Control,	.00	24	4,700	3,400	1,000	0	+	+	+
1.00,	.00	24	6	18	8	0	0	0	0
1.00,	.50	24	1	7	2	0	0	0	0
Control,	.00	24	12,500	220	180	+	+	+	+
1.50,	.00	24	30	20	0	0	0	0	0
1.50,	.75	24	18	17	3	0	0	0	0
Control,	.00	1	25,000	120	100	+	+	+	+
1.50,	.00	1	470	10	5	0	0	0	0
1.50,	.75	1	80	6	0	0	0	0	0
Control,	.00	24	13,000	50	20	+	+	+	+
1.50,	.00	24	27	5	0	0	0	0	0
1.50,	.75	24	10	2	0	0	0	0	0

Lawrence City Filters.

The source of the water supply of the city of Lawrence is the Merrimack River. Two filters are in use to purify this water. The older filter was constructed in 1893, and dividing walls separating it into three sections were built in 1902. This filter has a net area of 2.2 acres, and contains about 4 feet in depth of sand of an effective size of approximately 0.25 millimeter. It is not covered, and two sections have an earth bottom through which some ground water finds its way into the underdrains and becomes mixed with the filtered water. Construction of a concrete bottom in the east section was started during

1916 and completed during 1917. Bases were made in the concrete bottom for the pillars in case it is decided to cover this filter at some later date. Provision was also made for installation of a meter to measure the volume of effluent of this section. After sufficient preliminary operation water from this section was turned into the pump-well on August 31.

In November, 1907, a modern covered filter of concrete was put into operation to supplement the supply of filtered water from the old filter just described. This filter is three-quarters of an acre in area, and contains about 4½ feet in depth of sand of an effective size of 0.25 millimeter. The effluents from both of these filters flow into the same pump-well, from which they are pumped into the distributing reservoir. The average volume pumped daily is given in the pumping station records as about 5,250,000 gallons. While the repairs were being made on one section of the old filter a certain amount of water from the North Andover system was pumped into the Lawrence mains. Probably some of this water was present in some of the samples taken from the tap at the Lawrence Experiment Station.

The average analyses of the effluents from these filters, and of the samples from other points on the Lawrence water supply system, are shown in the following tables: —

Average Chemical Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

[Parts in 100,000.]

Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as —		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
				Albuminoid.								
	Turbidity.	Color.	Free.	Total.	In Solution.		Nitrates.	Nitrites.				
48	0.3	.41	.0129	.0199	.0164	.41	.019	.0004	.39	.0380	1.1	1.3

Effluent from Lawrence City Filter (Old Filter).

49	0.1	.33	.0136	.0084	-	.46	.036	.0003	.34	.0947	1.4	1.6

Effluent from Lawrence City Filter (New Filter).

50	0.1—	.40	.0030	.0091	-	.42	.031	.0007	.37	.0177	1.1	1.2

Average Chemical Analyses — Concluded.

Water from the Outlet of the Distributing Reservoir.

[Parts in 100,000.]

Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as—		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
				Albuminoid.								
	Turbidity.	Color.	Free.	Total.	In Solution.		Nitrates.	Nitrites.				
49	0.1	.35	.0059	.0087	-	.43	.035	.0002	.34	.0525	1.3	1.4
Water from a Tap at Lawrence City Hall.												
50	0.2	.36	.0042	.0088	-	.43	.038	.0001	.33	.0678	1.3	1.4
Water from a Tap at the Lawrence Experiment Station.												
51	1.1	.32	.0027	.0104	-	.46	.026	.0000	.28	.0520	1.2	1.3

Average Bacterial Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent. of Samples containing B. Coli.	
20° C.	37° C.		20° C.	37° C.			
	Total.	Red.		Total.	Red.	1 c. c.	100 c. c.
9,200	1,000	340	-	-	-	-	-
Effluent from the Lawrence City Filter (Old Filter).							
33	5	0.4	99.6	99.5	100.0	8	40
Effluent from the Lawrence City Filter (New Filter).							
24	5	1.0	99.7	99.5	99.7	17	64
Mixed Effluents as pumped to Distributing Reservoir.							
50	5	1.0	-	-	-	18	56
Water from Outlet of the Distributing Reservoir.							
50	5	0.5	-	-	-	11	47

Average Bacterial Analyses — Concluded.

Water from a Tap at Lawrence City Hall.

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent. of Samples containing B. Coli.	
20° C.	37° C.		20° C.	37° C.			
	Total.	Red.		Total.	Red.	1 c. c.	100 c. c.
36	4	0.4	-	-	-	8	40
Water from a Tap at the Lawrence Experiment Station.							
72	7	1.0	-	-	-	7	39

Refiltration of Lawrence City Water.

Filter No. 343A, $\frac{1}{20000}$ of an acre in area and constructed of sand of an effective size of 0.35 millimeter, was started in 1908. At the end of 1917 the depth of sand was 29 inches. Since July, 1913, water from the city mains has been applied at a rate of 5,000,000 gallons per acre daily.

The water as applied to the filter is aerated by falling about 2 feet to a splash plate, increasing the saturation by dissolved oxygen about 21 per cent. The average dissolved oxygen in the effluent was 59 per cent. of saturation, and the minimum was 33 per cent. The average color removal was 32 per cent., 1 per cent. higher than last year, and the per cent. reduction of iron was 51 per cent., considerably lower than in previous years.

Average Analyses.

City Water applied to Filter No. 343A.

[Parts in 100,000.]

Quantity applied. — Gallons per Acre.	Color.	Ammonia.		Chlorine.	Nitrogen as —		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
		Free.	Total Albuminoid.		Nitrates.	Nitrites.				
-	.28	.0041	.0114	.53	.022	.0003	.30	.0466	1.3	1.4
Effluent from Filter No. 343A.										
4,491,666	.19	.0047	.0089	.52	.028	.0001	.25	.0230	1.3	1.4

Sand Filters operated with Merrimack River Water at Different Rates.

Filters Nos. 417 and 419 have been operated since December, 1910, as part of a study of the efficiency of varying rates of filtration. When they were discontinued at the end of the year they contained 45 and 27 inches in depth of sand, respectively, this sand having an effective size of 0.25 millimeter. Merrimack River water was applied to each filter at rates of 2,500,000 and 7,000,000 gallons per acre daily, respectively.

The efficiency of Filter No. 417 has always been higher than that of Filter No. 419, as would be expected from the lower rate. The average per cent. saturation of dissolved oxygen in the effluent from the two filters has been 38 and 37, respectively, and the color reductions 44 and 32 per cent., respectively. Filter No. 417 was scraped nine times during the year, and Filter No. 419 sixteen times. This filter gave a great deal of trouble from becoming air-bound, especially in cold weather, when the applied water contained the largest amount of dissolved gases. The chemical and bacterial analyses are shown in a following table.

Preliminary Filtration through Coarse Material.

Filter No. 389A was rebuilt on Dec. 6, 1913, and now contains 54 inches in depth of small broken stones, of an effective size of 4.4 millimeters, over a $\frac{1}{8}$-inch copper screen raised 1 inch from the bottom. During the year the surface was raked once and washed twice. The surface layer and probably all the pebbles are covered with a gelatinous deposit, and it is undoubtedly this deposit that is responsible for the high bacterial efficiency and chemical purification of this filter of coarse material.

From January to April this filter was operated as a contact filter one cycle daily, and from April to August, two cycles daily. It was refilled immediately after draining each time. During the remainder of the year it was operated as a continuous filter. The object of operating it as a contact filter was to study the color removal under such conditions. The color removal was 43 per cent. compared with 18 per cent. when operated continuously, but the rate was less than one-tenth the continuous rate. The average chemical and bacterial analyses are shown in the following tables: —

Average Chemical Analyses.

Merrimack River (Canal) Water applied to Experimental Filters.

[Parts in 100,000.]

Temperature (Degrees F.).	Quantity applied. — Gallons per Acre.	Color.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. In Solution.	Chlorine.	Nitrogen as — Nitrates.	Nitrogen as — Nitrites.	Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
52	-	.41	.0164	.0189	.0154	.46	.023	.0008	.49	.0523	1.1	1.0
Effluent from Slow Sand Filter No. 417.												
55	9,472,000	.23	.0030	.0063	-	.45	.027	.0006	.29	.0664	1.0	1.2
Effluent from Slow Sand Filter No. 419.												
49	6,850,000	.28	.0036	.0091	-	.46	.032	.0002	.35	.0556	1.0	1.1
Effluent from Roughing Filter No. 389A (operated as a Contact Filter).												
52	800,000	.26	.0029	.0087	-	.36	.064	.0002	.30	.0270	1.3	1.5
Effluent from Roughing Filter No. 389A (operated as a Continuous Filter).												
55	9,472,000	.52	.0024	.0108	-	.60	.028	.0004	.41	.0448	1.2	1.3

Average Bacterial Analyses.

Merrimack River (Canal) Water applied to Experimental Filters.

Bacteria per Cubic Centimeter. 20° C.	Bacteria per Cubic Centimeter. 37° C. Total.	Bacteria per Cubic Centimeter. 37° C. Red.	Per Cent. of Bacteria removed. 20° C.	Per Cent. of Bacteria removed. 37° C. Total.	Per Cent. of Bacteria removed. 37° C. Red.	Per Cent. of Samples containing B. Coli. 1 Cubic Centimeter.
5,000	370	130	-	-	-	-
Effluent from Slow Sand Filter No. 417.						
42	7	2	99.2	97.5	98.6	29.0

Average Bacterial Analyses — Concluded.

Effluent from Slow Sand Filter No. 419.

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent. of Samples containing B. Coli.
20° C.	37° C.		20° C.	37° C.		1 Cubic Centimeter.
	Total.	Red.		Total.	Red.	
140	16	5	97.4	95.8	96.4	54.0
Effluent from Roughing Filter No. 389A (operated as a Contact Filter).						
900	60	35	82.0	84.0	73.0	96.0
Effluent from Roughing Filter No. 389A (operated as a Continuous Filter).						
290	30	9	94.0	92.0	92.0	74.0

DIVISION OF FOOD AND DRUGS.

HERMANN C. LYTHGOE, *Director and Analyst.*

Report of Division of Food and Drugs.

There have been few changes in the personnel of the Division during the year. Miss Katherine E. Rooney, assistant analyst, resigned, and her place was filled by Mr. Howard D. Williams. Mr. James S. Kenneally, inspector, resigned, and his place was filled by the employment of Mr. Charles A. Wells as assistant chemist and biologist. Dr. James M. Kingston was given an indefinite leave of absence. He is now in France as first lieutenant, Veterinary Corps, and his place has not been filled. The list of employees at the close of the year is as follows: —

Director of Division and Chief Analyst.
Hermann C. Lythgoe, S.B.

Assistant Analysts and Chemists.
Charles H. Hickey, S.B.
Lewis I. Nurenberg, S.B.
Clarence E. Marsh, A.B.
Howard D. Williams, Ph.B.
Charles A. Wells, A.B.
Leslie B. Coombs, A.B., S.M.

Inspectors.
Daniel E. McCarthy.
Frederick L. Marion.
Maurice P. Crowe.
Towneley T. French, M.D.
John F. McDonough.
Alvord H. Rose, D.V.S.
James M. Kingston, V.M.D.
George L. Drury, D.V.M.

Clerical.
Celeste E. Macaulay.
Eleanor J. Brogan.
Mary E. Touhey.

During the past twelve months the Division of Food and Drugs has been engaged in general routine work relative to the enforcement of the milk, food and drug laws, the examination of samples submitted by police departments and in the manufacture of arsphenamine.

The work of the laboratory has proceeded satisfactorily considering the lack of adequate space. This lack of space made it necessary practically to suspend research work relating to foods. It is planned to resume this work as soon as additional space, recently allotted to

the laboratory for this and other purposes, can be provided with the repairs and fittings needed.

At the beginning of the year there was put into operation a new system of daily reports for the inspectors. These reports are largely statistical. Through them the work can be more easily reported and much better judged and summarized than under the former system of reports. During the year 189 dairies and 42 milk plants have been inspected, 6,341 visits have been made to stores, 282 to bakeries, 154 to restaurants, 266 to food factories, 586 to slaughterhouses, 578 to cold-storage warehouses, 268 relative to cold-storage extensions, and 224 relative to cold-storage goods removed from warehouses. Special investigations have been carried out by the inspectors in 128 instances. The inspectors themselves have given 296 written warnings to violators of the laws.

There were examined in the laboratory 7,060 samples of milk, 1,704 samples of food exclusive of milk, and 794 samples of drugs. There were received from police departments for examination 272 samples of narcotics and other poisons, and 88 samples of liquor. The Massachusetts District Police submitted 11 samples of linseed oil and turpentine. The total number of samples examined was 9,929. This number is considerably less than that examined during 1916. This curtailment was the result of interference with work during repairs, and the use of space for necessary research work in the manufacture of arsphenamine.

There were prosecuted in the courts 307 cases, of which 271 were convicted. Of these cases 100 related to foods exclusive of milk, 28 related to drugs, 90 related to milk, 45 related to cold storage, and 44 related to slaughtering. The total fines imposed were $5,560.60. A number of cases have been referred to the United States Department of Agriculture for prosecution for violation of the Federal food laws. Most of these cases were milk cases, and the evidence was collected by employees of this Division. In two instances the Federal authorities refused to prosecute, and upon the other cases no report of action has been received. The United States attorney for Massachusetts, upon information received directly from this Department, caused seizures to be made of a number of samples of scallops shipped from the south. The cases which were based upon these seizures were instituted through the United States Department of Agriculture at its request, and subsequently that Department requested the United States attorney to place the cases in permanent abeyance because of the fact that the shippers lost the goods seized. Table I gives a summary[1] of the cases prosecuted in the Massachusetts courts.

[1] For a list of prosecutions under the food and drug laws, see appendix.

TABLE I. — *Summary of Prosecutions.*

Offence.	Cases.	Convictions.	Discharged.	Dismissed.	Held for Grand Jury.
Sale of low-standard milk,	5	3	2	–	–
Sale of skimmed milk as pure milk,	32	25	6	1	–
Sale of watered milk,	53	52	1	–	–
Sale of low-standard ice cream,	3	3	–	–	–
Sale of renovated butter,	1	1	–	–	–
Sale of preserved cider,	1	1	–	–	–
Sale of adulterated vinegar,	1	1	–	–	–
Sale of sweetened cocoa,	1	–	–	1	–
Sale of wormy chocolate almond bars,	1	1	–	–	–
Sale of stale eggs as fresh eggs,	12	9	3	–	–
Sale of adulterated hamburg steak,	13	12	1	–	–
Sale of adulterated lard,	3	3	–	–	–
Sale of adulterated maple sugar,	2	1	1	–	–
Sale of adulterated olive oil,	3	3	–	–	–
Sale of soaked peas,	2	–	2	–	–
Sale of adulterated sausages,	14	12	2	–	–
Sale of adulterated scallops,	20	20	–	–	–
Sale of decomposed food: —					
Eggs,	9	9	–	–	–
Meat,	4	2	2	–	–
Nuts,	4	4	–	–	–
Potatoes,	1	1	–	–	–
Shrimp,	2	2	–	–	–
Sale of tuberculous food,	2	2	–	–	–
Sale of adulterated drugs,	28	27	1	–	–
Absence of signs,	29	29	–	–	–
Failure to label cold-storage eggs,	15	15	–	–	–
Representing cold-storage goods as fresh goods,	1	1	–	–	–
Operating cold-storage warehouse without a license,	1	–	–	1	–
Violation of slaughtering laws,	44	32	11	–	1
Totals,	307	271	32	3	1

The total number of confiscations made because of decomposition was 124, amounting to about 305,000 pounds. Of this number, 41, or 295,683½ pounds, were in cold storage or were offered for storage;

26, or 4,969¾ pounds, were confiscated in slaughterhouses; and 57 in stores, amounting to 4,197 pounds, together with 761 barrels of vegetables, 5 cases of lemons, and 45 dozens of doughnuts.

The character and extent of, and the geographic, climatic and seasonal variations in food adulteration is little realized by those not actively engaged in the work relating to this subject. The State of Massachusetts has operated a food law for thirty-five years. The character of the work of the Department during this time has inculcated a wholesome respect for the law in most people doing business in this State. There is, therefore, very little adulteration of food and drugs in comparison with other localities where the inspection is not so thorough or so uniform. That the vendors of food and drugs know that eventually their products will be examined by this Department has a great influence towards improving the food and drug supply of the State. The history of the Department shows that little by little the food supply has been improved, until at present the work, with but few exceptions, may be compared with the policing of an extremely well-organized community. It has been found necessary from time to time to change the character of the samples collected, as the need of inspection decreased. This is best illustrated by Table II, compiled from the reports of the Department for 1898, 1905 and 1917.

TABLE II. — *Change in Character of Samples collected at Different Periods.*

Character of Samples.	1898.			1905.			1917.		
	Total Samples.	Adulterated Samples.	Per Cent. Adulterated.	Total Samples.	Adulterated Samples.	Per Cent. Adulterated.	Total Samples.	Adulterated Samples.	Per Cent. Adulterated.
Cocoa and chocolate,	36	17	47	17	4	23	7	3	-
Coffee,	157	15	9	46	6	14	4	-	-
Condensed milk,	48	18	37	23	2	9	3	-	-
Cream of tartar,	392	19	5	116	6	1	-	-	-
Honey,	94	14	15	32	1	3	5	1	-
Molasses,	135	12	9	35	-	-	4	-	-
Spices,	1,636	243	15	389	35	9	36	-	-
Sub-totals,	2,497	338	14	656	54	8	59	4	7
Per cent. of total samples,	67	-	-	30	-	-	3	-	-
Examined for Preservatives.									
Clams and oysters,	-	-	-	77	18	24	-	-	-
Hamburg steak and sausages,	-	-	-	149	81	54	60	18	-

TABLE II. — *Change in Character of Samples collected at Different Periods* — Concluded.

CHARACTER OF SAMPLES.	1898.			1905.			1917.		
	Total Samples.	Adulterated Samples.	Per Cent. Adulterated.	Total Samples.	Adulterated Samples.	Per Cent. Adulterated.	Total Samples.	Adulterated Samples.	Per Cent. Adulterated.
Examined for Preservatives — Con.									
Jams and jellies,	–[1]	–[1]	?	52	21	40	13	–	–
Ketchup,	–	–	–	21	12	57	4	–	–
Lime Juice,	–	–	–	17	17	100	–	–	–
Malt liquors,	–	–	–	312	118	38	–	–	–
Soft drinks,	10	5	50	127	26	20	17	1	6
Sub-totals,	–	–	?	755	293	39	94	19	20
Per cent. of total samples,	–[2]	–	–	35	–	–	6	–	–
Examined for Decomposition.									
Dates,	–	–	–	–	–	–	10	1	–
Eggs,	–	–	–	–	–	–	307	63	–
Fish,	–	–	–	–	–	–	16	5	–
Meats and meat products,	–	–	–	–	–	–	27	4	–
Nuts,	–	–	–	–	–	–	67	30	–
Shrimp,	–	–	–	–	–	–	25	6	–
Vegetables,	–	–	–	–	–	–	1	1	–
Sub-totals,	–	–	–	–	–	–	453	110	–
Per cent. of total samples,	–	–	–	–	–	–	27	–	–

[1] Several. [2] Less than 1.

In 1898, 67 per cent. of the food samples examined consisted of condensed milk, coffee, cream of tartar, cocoa, chocolate, honey, molasses and spices. In 1905 the character of these foods improved to such an extent that but 30 per cent. of the samples collected were of this class, and in 1917 conditions had further improved so that only 3 per cent. of the samples examined were of this class.

Of the total samples collected in 1898, less than 1 per cent. had to do with foods commonly treated with preservative; in 1905, 35 per cent. of the samples were of this class; while in 1917 the number had fallen to 6 per cent.

Of late years more attention has been given to decomposition in foodstuffs, and during 1917, 27 per cent. of the total food samples collected were examined with this in view, while in 1898 and 1905

practically no work was done of this nature. The increase in examinations for decomposition is due principally to recent advances made in the chemistry of food decomposition.

The changes in the character of food have resulted during recent years in the increase of the numbers of samples of perishable foods, with a corresponding decrease in those of non-perishable foods. This, of course, causes an undue congestion at times in the laboratory, as samples to be tested for decomposition must be examined soon after receipt. The spoilage of food is unfortunate, to say the least, and in many instances is caused entirely by the greed of dealers in foodstuffs. Investigations of this Division indicate the use of large quantities of rotten meat in sausages which are so highly spiced that the nature of the meat is not noticeable to the consumer. This meat can be purchased much cheaper than fresh meat. The cause of the spoilage of the meat is found one step nearer the producer. The butchers who supply the sausage manufacturers with such meat are obliged to buy cattle from the farmers, not when they desire to purchase but when the farmer desires to sell. If the price of beef is low the butchers, hoping for a rise in price, will hold the carcasses until such time as the meat is unfit for sale at retail, and then they will sell to the sausage manufacturer. Considerable meat of this character is, undoubtedly, from animals which have died other than by slaughter, and such meat is more liable to spoilage than the meat from animals slaughtered while in a healthy condition. In one sausage factory in New Bedford a large quantity of rotten meat was confiscated, and a sample of sausage intended for sale was obtained. This sausage was so highly seasoned that the odor was perfectly normal, although the analysis showed that decomposition had proceeded to an alarming extent. A second analysis was made twenty-four hours after the first analysis, and the results were identical, showing the presence of sufficient spice to preserve the meat, and therefore proving that the meat was decomposed before being made up. When the case was tried two chemists testified on behalf of the Commonwealth that the meat was decomposed before being manufactured into sausages, and for the defence a number of sausage manufacturers testified that the sausages decomposed while the inspector was carrying them to the laboratory. The court found the manufacturer not guilty, and at the same time convicted and imposed severe penalties on two other manufacturers for selling sausages containing starch in excess of 2 per cent.

Much of the decomposed food found in cold storage is due to a false impression possessed by many dealers that rotten food may be

placed in cold storage, and in some mysterious manner the process will make the articles satisfactory. Many instances are on record where dealers have held food too long at a high price against a falling market, and have placed the deteriorated articles in cold storage to be held until the next season. Salmon placed in storage on July 7 or thereabouts, and turkeys stored about December 1 and January 1, may be cited as examples of such practices. Delayed freight shipments are responsible in large measure for considerable of the decomposed food on the market. It frequently becomes the duty of the Department to confiscate such articles. Recently a carload of decomposed smelts was offered for storage. The car had been one month in transit from the Pacific coast. About six months ago 11 carloads of miscellaneous fish were confiscated by reason of decomposition caused by freight congestion *en route* from the Pacific coast. This fish was in such shape that it would have been impossible to dispose of any of it through the usual channels of trade, although a small portion could have been used for food purposes if cooked within a few hours.

Three instances of the sale of diseased meat were discovered. A tuberculous tongue was found in a store in Ware and the responsible person was prosecuted. Tuberculous lungs were found in Mansfield, but prosecution was impracticable owing to the impossibility of obtaining sufficient evidence. Tuberculous lungs were found in a Boston sausage factory, and after considerable difficulty the butcher who sold them was convicted. In the trial of the case the sausage maker who intended to use the diseased lungs did his best to help the butcher as well as to shield himself, his testimony in court being radically different in one particular to his statements to the Department. The case hinged upon the question of whether or not a sale was made. A conviction and fine was secured in the Superior Court.

The traffic in broken-out rotten eggs was fairly well eliminated by the work of the Department during 1916. A few instances of the sale of such eggs to bakeries and of their use by bakers were discovered and brought to the attention of the courts. The most fraudulent practice on the part of the egg dealers has been the sale of old eggs under the name of fresh eggs. There are practically no fresh eggs on the market during the months of December, January and February, and nearly all the eggs sold during these months are either cold-storage eggs or eggs held in storage at a temperature above 45° F. which need not be labeled cold-storage eggs. Attempts made to obtain definitions from the egg trade elicited the surprising information that there were three classes of eggs, — viz., rotten eggs as defined

by the senses; cold-storage eggs as defined by the statutes; and all other eggs entitled to be termed fresh eggs. These classifications did not seem to be satisfactory, and successful prosecutions were instituted for the violation of the false advertising law by selling old eggs under the name of fresh eggs, the dictionary being used to establish the meaning of the words "fresh eggs." Chemical examinations of market eggs have demonstrated that commercial cold-storage eggs have undergone but little alteration, while the so-called "fresh western eggs," which sell from 10 to 20 cents more per dozen, are well along in ripeness, and some have almost reached the state where they can be called decomposed. This condition is difficult to handle under our present laws.

Milk is the only important food which is subject to extensive adulteration notwithstanding the vigorous system of inspection carried out in the State. The Legislature of 1916 reduced the standard from 12.15 to 12 per cent. solids, and the quality of the average milk collected fell from 12.66 to 12.53 per cent. The price of milk advanced considerably, and the proportion of adulterated samples collected increased from 2.76 to 7.32 per cent.

The investigations of this Department showed that nearly all of this adulteration was practiced by the farmers and not by the milk dealers, as in only a few instances did an investigation of a milk dealer's dairies fail to show systematic watering on the part of some producers. One dealer appealed to the Department for help in order that he might obtain standard milk. An investigation of his sources of supply showed that the producer furnishing the largest quantity was adding 18 per cent. of water, notwithstanding that the dealer had warned him three weeks before that the milk was running low. After the warning the producer sent 21 cans instead of 42 cans. When one considers that the cows were capable of producing but 18 cans of milk, it is evident that the price paid for the water sold to the dealer as milk was considerable. In one case of this sort the judge trying the case computed the amount of money paid the farmer for water, and announced that the maximum fine of $200 which he imposed was insufficient to meet the ends of justice.

One reason for this increase in adulteration was the decrease in production. This phase was so marked that many dealers did not complain to their producers or to the Department until the conditions became intolerable. In one instance a dealer stated that he knew the producer was selling him watered milk, but he did not care to complain because he was afraid of losing the dairy. In this instance the milk dealer was prosecuted. Several dealers protested their innocence

but did not care to have the dairies investigated. Since investigation of the milk they received proved it to be satisfactory, the dealers were prosecuted and fined. The following table illustrates the deterioration of the milk sold in Massachusetts during the past year in comparison with that sold eight years ago: —

TABLE III. — *Composition of Average Milk not declared Adulterated.*

YEAR.	Number of Samples.	Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).
1909,	4,242	12.78	4.10	8.68
1910,	5,032	12.85	4.02	8.83
1911,	4,341	12.83	4.00	8.83
1912,	4,516	12.66	3.89	8.77
1913,	6,154	12.69	3.84	8.85
1914,	5,502	12.70	3.82	9.88
1915,	6,765	12.68	3.82	8.86
1916,	7,458	12.66	3.72	8.94
1917,	6,317	12.53	3.73	8.80

The food value of the milk sold in 1909 was 319 calories per pound, and that of the milk sold in 1917 was 307 calories, a decrease of 3.8 per cent. The average quality of the milk sold during 1909, 1910 and 1911 was 12.83 per cent. solids, 4.07 per cent. fat, 8.76 per cent. solids not fat, with a food value of 323 calories per pound. The average of that sold during 1915, 1916 and 1917 was 12.68 per cent. solids, 3.75 per cent. fat, 8.93 per cent. solids not fat, with a food value of 310 calories per pound. a decrease in food value of 3.7 per cent.

This condition of decreasing quality will, undoubtedly, continue until milk is graded and sold according to its food value as determined by the fat content.

Nothing unusual in the way of drug adulteration was discovered during the year. For several years past the Department had ceased to collect samples of camphorated oil because the last edition of the United States Dispensatory recognized camphorated oils of varying composition, and the United States Pharmacopœia did not recognize this name as synonymous with camphor liniment. The ninth edition of the United States Pharmacopœia, however, has recognized camphorated oil as a synonym of camphor liniment, and the druggists who have been making and selling that drug below strength are surprised to find that they must now sell it up to strength. One of the

analysts purchased a bottle of camphorated oil in Pittsfield, and as soon as he received the sample the inspector entered and proceeded to make a sealed sample for the druggist. The latter then said, "There is no U. S. P. on camphorated oil." The inspector informed him of his mistake and left the store. The druggist then telephoned to all the other drug stores not to sell any camphorated oil, and, consequently, he was the only druggist prosecuted.

The Legislature of 1916 passed "An Act to codify and amend the Laws relative to the Manufacture and Sale of Foods and Drugs," the law to take effect May 1, 1917. This law was primarily supposed to make the Massachusetts law uniform with the United States interstate food law, but it differs from that law in many particulars. There is a distinct gain in the enactment of the misbranding provision, but the repeal of the provisions of the present Massachusetts law relating to preservatives and to the sale of mixtures will be a misfortune. The new law does not apply to mixtures or compounds labeled "compound," "imitation" or "blend." Formerly, when this provision was in the Massachusetts law, it was successfully used for the sale of such mixtures as 95 per cent. cornstarch, 3 per cent. pepper, 1 per cent. charcoal and 1 per cent. cayenne, under the name of "compound pepper." These practices became so intolerable that the law was changed in 1897 by requiring the name and per cent. of each ingredient to be placed upon all packages containing such mixtures. This amendment to the law stopped most of the former abuses of the "compound" clause. In order to control the use of antiseptics, a special clause was added in 1901 requiring that the name and per cent. of these substances be declared upon the label. This, as stated in the annual report for 1905, "settled a much-vexed question; for, while the law prohibited the sale of foods containing ingredients injurious to the health of the consumer, authorities are by no means in agreement as to whether certain of these substances employed as preservatives exert an injurious influence on the system. The amendment waives the question, and leaves it to the consumer to decide whether he cares to assume the risk; but the vendor must acquaint him of the fact that the product is chemically preserved." It is very probable that conditions will revert to what they were prior to 1897, unless there is some provision in that portion of the new law relating to misbranding which will offer some means of control.

The cold-storage warehouses have been thoroughly inspected and kept in good sanitary condition. The cold-storage situation owing to conditions primarily brought about by the war, has been somewhat different from that prior to 1917. Massachusetts is an exporting

State, and large quantities of meat and fish have been shipped here to be held in storage pending shipment abroad. Consequently, the beef storage has advanced 20 per cent. over the 1916 storage, and the fish storage has advanced 50 per cent. Butter and eggs storage shows no material variation from the normal, but the poultry storage has been abnormal. During the holiday season of 1916 poultry sold at a rather high price, and the newspapers advised the public to boycott poultry, which advice was accepted. Consequently, the poultry went into the freezers to be held for summer hotel trade. On account of the war the summer hotel trade was unusually poor, and the poultry did not move as was anticipated. Another unforeseen difficulty arose when, owing to the advancing price of grain, the poultry farmers killed their flocks and thus flooded the market with fresh poultry, which further hampered the sale of this frozen poultry, as it appears to be impossible to sell frozen poultry and fresh poultry at the same time. During the year ending Sept. 30, 1916, there were placed in cold storage 15,459,091 pounds of poultry, of which 7,478,331 pounds, or 48 per cent., were stored during October, November and December, 1915, and 1,774,667 pounds were stored in April, May and June, 1916. During the year ending Sept. 30, 1917, there were placed in cold storage 21,007,833 pounds of poultry, of which 12,711,078 pounds, or 61 per cent., were stored during October, November and December, 1916, and 1,965,648 pounds were stored during April, May and June, 1917.

These figures substantially corroborate the claims of the poultry dealers that fresh birds were coming into the market during the season when cold-storage birds would ordinarily be sold. As a result of these conditions the poultry men asked this Department for extensions in storage, and at the same time the Federal Food Administrator asked this Department to confer with him upon all requests for extension. The Director of the Division then informed him that several requests had been received and would be granted unless he showed the Department good reasons why they should not be granted. The Food Administrator then asked the Department to suspend all action upon extensions until his committee had considered the situation. He was informed by the Department that the extensions had been granted, as action upon these requests must be taken within a few days of receipt of the requests for extension, as the articles must come out of storage within twelve months of the date of storage, unless the State Department of Health gives consent to let them remain there. Subsequently the Food Administrator held several conferences with poultry dealers, which the Director of this Division was invited to attend, and

in October he requested the Department to grant extensions on poultry of one month for one-half the stock on hand and of four months upon the balance. This the Department has rigidly adhered to, except in those instances where requests have been received for shorter periods.

In comparison with the total goods stored the extensions are very small, being only 0.12 of 1 per cent. during the past year. Of the 179 extensions granted, 142 were for poultry, the total weights of all articles being 241,857 pounds, and of poultry, 160,853 pounds. The following tables give a summary of the extensions granted, extensions refused, requests for removal granted, and goods ordered out of storage. The time of extension varied from three weeks to six months, averaging two months.

TABLE IV. — *Cold-storage Extensions granted.*

ARTICLES.	Number of Requests granted.	Total Weight (Pounds).
Broken-out eggs,	2	130
Butter,	3	2,640
Poultry,	142	160,833
Beef,	3	30,122
Lamb,	5	721
Pork,	7	27,054
Miscellaneous meat products,	6	1,581
Fish,	9	18,756[1]
Fruit,	2	57[2]
Totals,	179	241,857[3]

Requests granted, 1914,	138
Requests granted, 1915,	218
Requests granted, 1916,	127
Requests granted, 1917,	179

Relation between weight of extensions and one year's total storage, 0.12 per cent.

Time of extension, one to six months. Average, two months.

[1] 6,000 pounds for bait. [2] Crates. [3] And 57 crates.

TABLE V. — *Cold-storage Extensions refused.*

Articles.	Number of Lots.	Total Weight (Pounds).
Broken-out eggs,	1	90
Poultry,	10	4,190
Beef,	3	1,722
Pork,	1	10,558
Miscellaneous meat products,	1	229
Fish,	1	392
Fruit,	1	2[1]
Totals,	18	17,181[2]

[1] Crates. [2] And 2 crates.

TABLE VI. — *Cold-storage Requests to remove granted.*

Articles.	Number of Lots.	Total Weight (Pounds).
Butter,	1	30
Poultry,	4	649
Miscellaneous meat products,	3	340
Totals,	8	1,019

TABLE VII. — *Lots in Cold Storage ordered out.*

Articles.	Number of Lots.	Total Weight (Pounds).
Broken-out eggs,	2	915
Butter,	4	798
Poultry,	13	2,805
Miscellaneous meat products,	9	1,055
Beef,	2	5,836
Pork,	1	420
Fish,	9	2,783
Totals,	40	14,612

In the enforcement of the slaughtering laws the Division made a radical change in policy by causing the inspectors of this Department

to act as instructors to the local inspectors of slaughtering whenever such action was desired or was necessary. As a portion of this work, meetings were held at which the local inspectors were invited, and the various phases of the work were discussed. The Director of the Division and Dr. Drury attended all the meetings, and at some of the meetings the District Health Officers were present. The meetings were held in Springfield, Pittsfield, Greenfield, Worcester and Barnstable, and stenographic records were taken of all the discussions. For making arrangements for these local meetings the Department is indebted to Mayor Frank E. Stacey of Springfield, Dr. Collins of Pittsfield, Mr. Lee and Dr. Pfersic of Greenfield, Mr. Coffee and Mr. Berg of Worcester, and Mr. Mecarta of Barnstable. In general, the meetings were satisfactory. There were discussions of the laws, of the character of post-mortem examinations to be made, and of the relation between this Department and the local inspectors. One of the meetings was distinctly different from the rest, due to the exhibition of considerable animosity towards the Department. As the result of this animosity it was necessary to go into details and state that many of the inspectors in that district were not doing their duties in a proper manner, as indicated by the character of the reports made by the local inspectors. The meeting ended with a much better feeling, and the reports made by the local inspectors since that time, as well as the reports made by our own inspectors, show a marked improvement in the character of the inspection made in that district. The reports of the local inspectors throughout the State show an improvement in inspections over those of a few years ago.

There were 197,070 carcasses inspected, — 55 less than during 1916, — of which 30,554 were cattle, 90,663 were calves, 72,846 were hogs, 2,999 were sheep, and 8 were goats. This was an increase of 2,007 cattle and 9,810 calves, and a decrease of 8,063 hogs and 3,817 sheep. The percentage of carcasses confiscated during the past three years is as follows: —

	1915.	1916.	1917.
Total,	1.27	1.41	1.58
Cattle,	2.29	2.29	2.08
Calves,	1.18	1.97	2.23
Hogs,	1.02	0.62	0.54

There were 34 localities in which no confiscations were made where sufficient animals were slaughtered to indicate that some must have

been diseased. This is a decided improvement over conditions reported in 1916, as there were 79 such localities that year. The prevailing causes for confiscation were tuberculosis, hog cholera, pneumonia and immaturity. The percentage of these diseases compared with the total confiscations is distributed as follows: —

Diseases.	Cattle.	Calves.	Hogs.
Tuberculosis,	86.6	0.9	30.6
Hog cholera,	–	–	45.6
Pneumonia,	0.6	–	11.9
Immaturity,	–	90.6	–
	87.2	91.8	98.1

Table VIII gives the summary of nominations by local boards of health for the position of inspector of slaughtering, March 31, 1917, to Dec. 1, 1917.

Table VIII. — *Nominations by Local Boards of Health for Inspector of Slaughtering, March 31, 1917, to Dec. 1, 1917.*

Number of nominations made by local boards of health,	513
Number of nominees approved by the State Department of Health,	468
Number of nominees disapproved by the State Department of Health,	20
Number of nominees upon which the State Department of Health took no action,	25
Nominations made late in the year, still pending,	8
Cities and towns making no nominations,	8

Of the total number of nominations made, 73 were new nominees.

Of the nominees approved, 13 resigned and 5 died.

Of the nominees disapproved, 2 were reconsidered and approved.

In connection with the special work done by the Department in Ayer and vicinity, this Division furnished the services of three men, one of whom was practically a full-time man. A small chemical and bacteriological laboratory was installed in the departmental headquarters at Ayer, and a number of chemical and bacteriological examinations were made of milk and other foods sold in Ayer or sold to the cantonment. Nearly all the restaurants were serving skimmed milk. After the Department had obtained sufficient evidence to warrant prosecution, a hearing was given to all these people, at which they were informed that a continuance of the practice of selling skimmed milk would result in prosecution of all the cases the De-

partment had obtained. The restaurant keepers were informed that a continuance of the methods employed would inevitably result in the sale of skimmed milk, and they were advised to either purchase their milk in one-half pint bottles from reputable dealers, or else to buy their milk in quantity from reputable persons and bottle it themselves. The restaurant keepers accepted the advice of the Department, and since that time no further evidence of the serving of skimmed milk in restaurants in that district has been obtained.

In connection with the sanitary survey of that district all the dairies were scored, and the records of these scores were placed in the files at the Ayer office for the use of the various local boards of health. An unsuccessful attempt was made to have the various towns in the Community Health Council appoint one of the employees of this Division a local milk inspector for all the towns. Only two of the nine towns agreed to do this, and the attempt was, therefore, abandoned. The town of Ayer, however, requested that one of the employees of this Department be made an agent of the Ayer board of health to serve without pay. Dr. Drury was detailed to undertake this work, and he was successful in radically improving unsanitary conditions in the town.

The Division has devoted considerable time and energy towards the manufacture of arsphenamine upon a factory scale. This has not as yet been completely established, owing to lack of space. As soon as the space allotted to the Division becomes available for this purpose we will be able to make from 1,500 to 2,000 doses per month. The process as carried out by this Department is substantially as follows: Arsanilic acid is made from aniline and arsenic acid, and is separated by means of its sodium salt. Apparatus has been made but not yet installed for the recovery of the excess of aniline. The crude arsanilic acid is purified by solution in sodium hydroxide and precipitation as atoxyl. There are two by-products formed in this reaction, both of which must be recovered. From the atoxyl is prepared arsanilic acid, which is then fused with oxalic acid and the melt purified by washing with water and with hydrochloric acid. The residue is then dissolved in sodium hydroxide and after filtration is precipitated by acid. The precipitate is then nitrated and the nitro body purified by recrystallization from boiling 50 per cent. acetic acid. It is necessary to recover the acetic acid after the recrystallized nitro body has been filtered. The animo group is then split off from the nitro compound by means of sodium hydroxide, and the oxyacid compound is precipitated with acid. This compound is then purified by recrystallization from boiling water. The arsphenamine base is then

made from the oxyacid compound by the reduction in alkaline solution with sodium hydrosulphite. This process must be carried out without undue access of air. The precipitated base is filtered through a filter press, washed thoroughly, pressed dry and dissolved in a mixture of anhydrous methyl alcohol and hydrochloric acid. This solution is then poured into anhydrous ether and the compound desired precipitates. The precipitate is then filtered, washed with ether, dried in a vacuum desiccator and placed in ampoules. The first lot of the pure compound was made upon a small scale at the close of the last fiscal year. Since that time several lots have been made, some of which were found to be impure, while other lots were found to be good. It is believed that all the variations in the processes which will lead to impure compounds have been discovered, and that in the future it will be possible to obtain a pure compound with each batch made. At present 300 doses are on hand and have been pronounced satisfactory by Dr. Reid Hunt. It is advisable to hold these for a reasonable time before distribution, in order to ascertain whether the process employed in the bottling is sufficient to render the article stable.

In the appendix will be found the list of prosecutions, the summary of the milk, food, drugs, poisons and liquor examinations, a list of cold-storage extensions granted and refused, a list of the requests for immediate removal from storage granted, a list of goods ordered out of storage, and a summary of the reports of local inspectors of slaughtering, with explanations upon the various tables.

Division of Communicable Diseases.

Eugene R. Kelley, *Director*.

Report of Division of Communicable Diseases.

Prevalence of Diseases Dangerous to the Public Health.

During the calendar year of 1917, 80,239 cases of diseases dangerous to the public health were reported. On May 1, 1917, lobar pneumonia was added to the notifiable list. During the balance of the year 1,756 cases were reported. Deducting these from the total, the cases of disease reported for 1917 represent an increase of 10,675 cases as compared with 1916.

This increase was for the most part due to three unimportant diseases, — chicken pox, German measles and mumps. To offset this there were distinct decreases in several serious diseases, notably, anterior poliomyelitis, measles, scarlet fever and whooping cough. On the whole, it may be said that the communicable disease situation remained satisfactory throughout the year.

Diphtheria was unusually prevalent for many months during the year, particularly in Boston and vicinity. Cases were scattered, seldom reaching a prevalence that could be considered epidemic. The total number of cases reported was 10,322, exceeding those in the previous year by 3,040. The number of fatalities correspondingly increased from 629 deaths in 1916 to 838 in 1917.

The typhoid fever showing for 1917 was peculiarly gratifying, since it shows conclusively that the low mark reached in 1916 was not an accident; 31 more cases were reported in 1917 than in 1916, — a total of 1,546 as against 1,515. There was also a slight increase in the number of deaths, 178 as compared with 172 for the previous year, but, making the proper allowance for increase in population, the typhoid death rate is unchanged for the two years, remaining at the low mark of 4.6 per 100,000.

Anthrax has continued to increase for the past three years, with a total of 54 cases reported for 1917, the greatest number ever reported in the State. A thoroughgoing investigation was made of each case of anthrax as reported. A special report of this work is printed in the appendix, which shows that the increase in anthrax in Massachusetts in the past few years is due entirely to the importation of foreign hides from sources not previously drawn upon, which are frequently seriously infected with anthrax and for which the methods

of disinfection now employed prior to importation into this country are entirely inadequate. Strong representations have been made to the Federal authorities responsible for the importation of hides and wool into this country, and a careful investigation is being carried out with a view to rendering imported hides, wool and hair safer for our workmen.

Smallpox also prevailed to a greater extent than in the preceding year; 65 cases were reported with 10 fatalities. The majority of cases occurred in an outbreak in Worcester during the early months of the year. An account of this outbreak is given in the appendix.

The total number of cases of communicable disease reported for both 1917 and 1916, arranged in order of greatest increases and decreases, follows: —

Relative Occurrence of Reportable Diseases, 1916–1917.

	1916.	1917.	Increase.	Decrease.
German measles,	591	5,890	5,299	–
Mumps,	2,318	7,125	4,807	–
Diphtheria,	7,282	10,322	3,040	–
Chicken pox,	4,672	7,210	2,538	–
Lobar pneumonia,[1]	–	1,756	1,756	–
Tuberculosis (pulmonary),	7,878	8,365	487	–
Ophthalmia neonatorum,	1,932	2,325	393	–
Tuberculosis (other forms),	657	776	119	–
Septic sore throat,	159	270	111	–
Epidemic cerebrospinal meningitis,	150	196	46	–
Dysentery,	119	160	41	–
Smallpox,	32	65	33	–
Typhoid fever,	1,515	1,546	31	–
Anthrax,	31	54	23	–
Glanders,	–	2	2	–
Hookworm disease,	–	1	1	–
Leprosy,	2	3	1	–
Actinomycosis,	4	4	–	–
Trachoma,	88	87	–	1
Tetanus,	34	28	–	6
Dog bite,	71	60	–	11
Pellagra,	47	29	–	18
Malaria,	97	78	–	19
Trichinosis,	24	3	–	21
Scarlet fever,	6,271	5,953	–	318
Measles,	25,460	23,880	–	1,580
Anterior poliomyelitis,	1,927	174	–	1,753
Whooping cough,	6,447	3,877	–	2,570
	67,808	80,239	18,728	6,297

[1] Made reportable May 1, 1917.

Epidemics and Outbreaks.

The Commonwealth has suffered but little during the year from epidemics and serious outbreaks of communicable diseases.

The Division has investigated in detail all outbreaks of any importance and many of minor character, a total of 203. A brief summary of some of them is given in the appendix, in the report of the epidemiologist.

The most striking outbreak of disease was the occurrence of smallpox in Worcester during the months of March, April, May and June. Of the 48 cases in this outbreak 38 were in Worcester. The remaining 10 cases, in adjoining cities and towns, had been in direct contact with cases in Worcester. This outbreak was particularly interesting because the source of infection was traced to a newly arrived immigrant. It is of further interest to note that a still more severe outbreak of smallpox in Minnesota was traced to immigrants arriving by the same vessel.

Two outbreaks of typhoid fever occurred in Gardner, though all the cases in both outbreaks proved to have a common source of infection, — a carrier engaged in the milk business. The first outbreak of 20 cases occurred in April and May, the second during August and September, with a total of 60 cases. The important lesson to be learned from these two outbreaks is that it is never safe to allow a known typhoid carrier to have anything to do with the production and distribution of milk.

An outbreak of typhoid fever, numbering 64 cases with 5 deaths, occurred in the Tewksbury State Infirmary during September and October.

The typhoid situation of Fall River remained extremely unsatisfactory throughout the latter part of the year. The disease could not be in any sense called epidemic. It has exhibited an endemic prevalence far beyond any other community in the State.

From May to December 239 cases were reported. The Fall River board of health has made every effort to trace the source of this unusual prevalence. In this effort the District Health Officer and the epidemiologist have assisted, but no clear explanation of the high typhoid rate has been obtainable. A policy of hospitalization has been adopted, the prompt tracing of contacts and their immunization with typhoid vaccine. It is hoped that these measures will result in a greatly lessened typhoid prevalence during the coming year.

There were four epidemics of septic sore throat during the year, each outbreak being traced to infection through milk. Nearly 600 cases occurred during these four outbreaks. In two instances raw milk was used, and in two others investigation showed that pasteurization had been either temporarily discontinued, or that it was being carried out in such an imperfect manner as to render it easily possible for the milk to become infected.

At various times during the year measles has been epidemic in all portions of the Commonwealth except in the southern part of Worcester County.

In marked contrast to its widespread prevalence during 1916 it is extremely interesting to note that anterior poliomyelitis occurred in the form of an outbreak in but one locality, in Haverhill, where 35 cases were reported from June to September, inclusive. Investigation of this outbreak showed in one or two instances the possibility of infection through contact, but no general source of infection could be traced. For several years past anterior poliomyelitis has occurred in Haverhill to a greater degree than in other cities of the State.

The year 1917 was characterized by five outbreaks of dysentery, two in State institutions for the insane, two in educational institutions and one, which was very mild in character, widespread throughout a large city. The outbreak of dysentery which occurred in the Medfield State Hospital in September and October was of a peculiarly malignant character, there being 31 deaths in a total of 60 cases, a fatality rate of more than 50 per cent.

Although diphtheria for 1917 showed an increase in cases reported over the preceding year, as already noted, epidemics and outbreaks were few. Two outbreaks occurred in Lowell, one, with 314 cases, during the period January to July, the other, with 119 cases, during November and December.

Gardner also had two outbreaks, both in the same school, the first with 87 cases, from January to March, the second continuing from August to November, with 110 cases. A school nurse employed late in the year, during her first month's work found in homes 12 concealed cases of diphtheria. Measures taken by the local board of health in regard to these cases quickly terminated the outbreak.

In both Lowell and Gardner the disease prevailed largely among the foreign element in the population, and much difficulty was encountered in locating early cases and carriers.

In addition to several distinct outbreaks due to school contact, diphtheria prevailed in a number of localities where it was impossible to trace the disease to any definite source. Boston, with 1,186 cases reported from October to December, inclusive, affords a good example of this condition. While it was evident that the disease was more prevalent in certain wards, and it was probably being spread by carriers, at no time could any distinct epidemic or outbreak be distinguished.

A similar situation existed in Cambridge, Chelsea, Malden, Melrose and certain other towns in the vicinity of Boston in the first half of the year, and in Springfield during the latter part of the year.

Routine Epidemiological Work.

A full statement of the developments which have taken place in epidemiological procedure during the year will be found in the report of the epidemiologist, in the appendix.

Individual case records with a continual "follow-up" for cases of pulmonary tuberculosis have been gradually improved and extended in the past three years. In addition the Division is now endeavoring to obtain case histories of anterior poliomyelitis, anthrax, cerebrospinal meningitis, smallpox and typhoid fever, and of rare diseases, such as leprosy, tetanus, trichinosis and pellagra. These are not only of great value for current study and investigation, but records of this nature will be of permanent value in years to come.

The most important innovation in routine epidemiological procedure has been to obtain a detailed history of each case of typhoid fever reported. Through the co-operation of boards of health in the larger cities, the District Health Officers and the epidemiologist the histories are recorded on a standard duplicate sheet furnished for the purpose. One copy is retained by the local board of health, and the other is returned to the Department. Wherever it can be determined, cases are grouped according to the source of infection. Subsequent histories from any given locality are compared with those already filed, to note any possible common factor. As time goes on this will lead to the detection of a number of typhoid carriers.

Known typhoid carriers are periodically relocated. Individual cases are located on maps, which indicate by means of colored pins and beads the month in which the case was reported and the source of infection (milk, water, carrier, etc.).

Another epidemiological method inaugurated and perfected during the year is the checking up of reports of diseases from local boards of health with the positive reports from the diagnostic laboratory. Reports from the laboratory are held a reasonable time to allow for the official report of the case to be received from the local board of health. At the end of this period, if found not to be reported, they are brought to the attention of the physician concerned and to the local board of health. A considerable number of unreported cases have been brought to light in this manner. In a great majority of cases the absence of reports was found due to the failure of the local board of health to transmit information received, particularly in the small towns.

A system of interstate reciprocal notification was also put into effect during the year. All cases of disease originating without the State have been referred to the State from which apparently they

received their infection. Information concerning cases infected in this State traveling into adjoining States and exposing certain people to the disease has been referred to the authorities of the respective States. The interstate reciprocal notification, like the intrastate, is based on the length of the incubation period of the different diseases.

During the year typhoid fever was imported from three communities in Canada. These were reported to the provincial authorities interested, affording them valuable information. Four cases reported from Holyoke, Fitchburg and Fall River were students at convents in Quebec and the neighboring town of Drummondville. According to the Canadian authorities these cases occurred probably as the result of the failure to carry out a system of chlorination of the water supply obtained from the Yamaska River.

Another typhoid fever case originated in a munition plant at Welland, Ontario.

Acting under the authority of Revised Laws, chapter 75, section 8, as amended by the Acts of 1913, chapter 670, the following regulation relating to the existence of infectious diseases on the premises of milk handlers was adopted by the Public Health Council on April 3, 1917: —

Voted, That beginning May 1, 1917, it shall be the duty of the officers in charge of any city or State institution, charitable institution, public or private hospital, dispensary or lying-in hospital, or any local board of health in any city or town, to give immediate notice (preferably by telephone or telegram, "collect") to the State Department of Health, State House, Boston, or to the State Health Officer of the district, of every case coming to their notice in which typhoid fever, dysentery, diphtheria, scarlet fever or tonsillitis has occurred in the household of any person engaged in the production, transportation or distribution of milk for public sale; and of every case coming to their notice in which typhoid fever, dysentery, diphtheria, scarlet fever or tonsillitis has been due, or presumably has been due, to the consumption of milk infected with material derived from persons infected with said diseases.

The co-operation of the local boards of health in the past has resulted in a marked diminution of milk outbreaks and epidemics, and further co-operation in carrying out the above method will result in a still greater reduction of epidemics due to milk.

Work of the Diagnostic Laboratory.

The work of the diagnostic laboratory has continued along the same lines as in previous years. The total number of examinations made for the year ending Nov. 30, 1917, was 22,480, substantially the same number as was examined in the previous fiscal year.

Fewer cultures for diphtheria were examined than in the preceding

year, in spite of the fact that diphtheria was decidedly more prevalent throughout the State. The increased incidence of diphtheria, confined to larger cities and towns maintaining their own diagnostic laboratories, and the smaller number of school cultures examined were responsible for the decrease.

Examinations for tubercle bacilli showed the greatest increase in number of specimens submitted.

Widal examinations were somewhat less than for the previous year, but specimens submitted for the culture test for typhoid fever were more than doubled, 718 such specimens being examined. Typhoid bacilli were isolated forty-five times. Eight new carriers were located, two of whom were milk handlers and responsible for epidemics of typhoid fever.

The determination of pneumococcus types in sputum was begun in the last two months of the year. The technique of the Rockefeller Hospital was followed, and 63 specimens were examined. This work is being carried on at the present time on a limited scale in conjunction with the use of anti-pneumococcic serum. The serum is furnished to certain hospitals in close proximity to the laboratory. Diagnosis of the type of pneumococcus present in cases of lobar pneumonia, in order to determine the proper curative serum, seems most promising. If it can be made sufficiently practicable, not only for the needs of hospital treatment but for cases treated in private practice, it is not unreasonable to expect a great reduction in the fatality from pneumonia.

Work of the District Health Officers.

Several changes in personnel have taken place during the year. Following the resignation of Dr. Walter H. Brown as epidemiologist, Dr. Stanley H. Osborn, District Health Officer of the Berkshire District, was appointed his successor on Jan. 15, 1917. Dr. Howard A. Streeter of Marblehead, as the result of a competitive examination, was appointed to take Dr. Osborn's place in the Berkshire Health District.

On June 18, 1917, Dr. George T. O'Donnell of Waltham was appointed Acting District Health Officer of the South Midland District, to take the place of Dr. William W. Walcott, who was granted a leave of absence for the duration of the war. Dr. O'Donnell's appointment was made permanent on Nov. 1, 1917.

The total average working hours for the calendar year for the eight District Health Officers was 2,647 each, which is equivalent to seven and a quarter hours' working time for every day in the year, including

Sundays, holidays and vacation. The average annual mileage for each of the District Health Officers was 12,000 miles.

The work of the District Health Officers, varied and interesting, has been maintained on the same high standard as that set in previous years. It has consisted largely of field work, dealing principally with boards of health and communicable diseases. Assistance has been rendered other divisions of the Department. It has involved much necessary and increasing clerical work in keeping records up to date, keeping the office informed of their activities and attending to correspondence. The need for some form of field and office assistance is greater than ever before.

Among their activities may be mentioned the following: —

Conferences with boards of health relative to the health situation in the cities and towns of the district.

Investigating outbreaks and probable outbreaks of communicable diseases.

Investigating cases of ophthalmia neonatorum and suppurative conjunctivitis.

Investigating cases of dog bite requiring antirabic treatment; supervising administration of treatment.

Lecturing on health subjects.

Inspection of tuberculosis and communicable disease hospitals.

Inspection of tuberculosis dispensaries.

Inspection of police stations, lockups, county jails and houses of correction.

Advising with boards of health regarding nuisances.

Attending conferences of the District Health Officers and meetings of the Health districts.

Arranging for clinics for the after care of anterior poliomyelitis.

Inspection of "farm camps."

Arranging for administration of typhoid and paratyphoid prophylactic, toxin-antitoxin, Schick test, etc., at institutions.

Conferences with county commissioners on the county tuberculosis hospitals.

Special work, as examining students at Massachusetts Institute of Technology for military purposes, and assisting in examining residents of Framingham for detection of tuberculosis and other diseases for the Community Health Station.

Fortunately, the District Health Officers have not been called upon for assistance in epidemics on any such scale as was the case during the anterior poliomyelitis outbreak of 1916. As has been pointed out in previous years, the general tendency of the communicable disease situation in the State is to a decrease in the number of serious outbreaks and the number of cases involved.

The most important constructive activity of the District Health Officers has been an effort to extend public health nursing. Each of them has brought to the attention of local boards of health and to the

public on every suitable occasion the benefits of public health nursing service, and as a result many new public health nurses have been employed in various parts of the State.

They have also been called upon, more than ever before, to advise with boards of health as to rules and regulations for the control of communicable diseases and for the standardization of procedure. Following the formal promulgation of a set of rules by the Public Health Council, the subject was taken up with boards of health, and in some instances the rules have been adopted in their entirety.

One of the routine duties of the District Health Officers, which in the past has taken considerable of their time, is the investigation of nuisances. Numerous complaints were received during the past year, but only a few were serious enough to warrant special investigation by the District Health Officers and conferences with the local boards of health. In a number of instances neighborhood differences were evident.

The policy of referring these matters to the local boards of health, to whom the statutes have given the responsibility and authority for abatement, has been strictly adhered to. Apparently the effect has been good, not only in discouraging unwarranted complaints but in making the local boards realize that the question of a nuisance is one for them, and for them only, to decide.

The Cape black fish situation forced itself upon the attention of the Department early in May, 1917, and again in July and November. The Governor and Council, on appeal, granted an allowance of $700 for abating the nuisance, contracts were made, approved by the Department and the nuisance finally removed. Special legislation to provide against a repetition of this trouble is sought, and a bill will be introduced in the Legislature which, if passed, will do away with such nuisances in the future.

The "offensive trade" nuisance in Natick — the rendering of scraps and bone — was brought up again early in the year. After a conference between the local board of health and two of the State District Health Officers an agreement was reached that if the industry in question were allowed to go on during the cold months of the year, a less offensive process would be used during the warmer months.

During the latter part of the year the District Health Officers were much occupied in co-operation with the Department's committee on child conservation in carrying out surveys to determine what additional agencies are desirable and necessary for lessening infant and child mortality in individual cities and towns.

Each District Health Officer was appointed a vice-chairman of the

committee on medicine, hygiene and sanitation of the State Committee on Public Safety. The work in this respect was practically that of classifying and listing the available medical, nursing and hospital resources of their districts.

The war has brought about additional burdens for the District Health Officers, due in part to the assistance they have been called upon to give various military and civilian bodies interested in different aspects of war activity. Their services have been largely in demand in consulting with local authorities as to the best readjustments to be made in personnel in consequence of the entrance into military duty of many physicians in private practice, members of boards of health, health officers and public health nurses.

Special Work of the Division.

The decision to establish a cantonment for the national draft army at Camp Devens, in the town of Ayer, immediately created a sanitary problem. The Commissioner of Health at the first adopted the policy that the local authorities of Ayer and the neighboring towns should not be called upon to carry out extraordinary sanitary work imposed by the location of the camp. Furthermore, he laid down a policy that such extraordinary work should be financed by the Federal government. This principle has since been accepted throughout the country, but at the time of the establishment of this camp the Federal government had made no provision for the sanitary work in extra cantonment zones. For that reason the Commissioner of Health, on May 21, 1917, made certain recommendations to the Governor (see Commissioner's Report, page 23).

Subsequently the Governor sent a special message to the Legislature urging an appropriation for extra cantonment work in the vicinity of Camp Devens, to be expended under the direction of the State Department of Health. The sum of $20,000 was appropriated for this purpose.

District Health Officers Simpson, Finnegan and Walcott were appointed a special board to survey the situation and to recommend the type of sanitary organization. Dr. Walcott being called shortly to military duty, Drs. Simpson and Finnegan perfected a permanent organization which consisted of representatives of the health authorities of eight towns immediately adjacent to the camp, who organized under the name of the Community Health Council. Dr. Finnegan, District Health Officer, was made chairman of this council, and Mr. E. S. Barry, chairman of the Ayer board of health, was appointed secretary of the council.

Under the general supervision of Drs. Finnegan and Simpson the extra cantonment sanitary work was carried on with the co-operation of the local boards of health, and of the military authorities after the camp was opened.

A sanitary survey was made of all the premises in the immediate vicinity of the camp. Additional nurses were employed for school work. One of the inspectors of the Food and Drug Division acted in co-operation with the local board of health in maintaining proper sanitary control of restaurants, groceries, etc. A first-aid station was established at headquarters. A clean-up campaign was inaugurated and carried out.

The Division has co-operated freely with the Community Health and Tuberculosis Demonstration at Framingham at various times during the year. Personal conferences and advice from the District Health Officer have been supplemented by several of the District Health Officers who assisted for brief periods in the physical examination of applicants.

The policy of urging institutional authorities to immunize inmates and attendants against typhoid fever has been adhered to throughout the year.

The director of the Commission on Mental Diseases has been particularly helpful in forwarding this policy of immunization against typhoid in institutions. All employees and inmates of State insane hospitals are now immunized as a routine procedure.

The problem of inducing active immunization against diphtheria in State institutions caring for children is far more difficult in its technique than that of typhoid immunization. The medical officer of the Industrial School at Shirley, where diphtheria has been particularly prevalent in past years, has set an excellent example in carrying out active immunization against diphtheria among the inmates of the school. The School for Feeble-minded at Wrentham has also carried out a complete immunization against diphtheria.

The year's progress with reference to the county tuberculosis hospitals has been satisfactory. At the present time every county save one has either arranged for the care of its tuberculosis patients by contract with existing institutions, or has purchased a site and prepared building plans which have been approved by this Department. Bids for complete or partial construction have been received. It is expected that active construction will begin early in 1918.

As the result of an act of the Legislature, calling for tuberculosis surveys by representatives of this Department and the Trustees of Hospitals for Consumptives in cities and towns desiring subsidy on account of consumptive patients, a detailed survey of the tuberculosis

situation in New Bedford, covering several months, was carried out under the direct supervision of Dr. A. S. MacKnight, District Health Officer of the Southeastern District, representing this Department, and Miss Bernice W. Billings, representing the Trustees of Hospitals for Consumptives. The report of this survey appears in the appendix.

As a further means of detecting tuberculous persons in the State and assisting us in efforts to minimize the danger of tuberculosis in the civilian population and to render assistance to such persons by placing them under the supervision of the proper health authorities, the Commissioner of Health, on Aug. 8, 1917, recommended to the Governor that a circular letter signed by him be sent to the medical examiners of exemption boards, urging them to co-operate with the State Department of Health by keeping an exact record of all persons rejected for tuberculosis under the selective service act, and reporting the same to this Department.

Acting upon this recommendation, the Governor sent out such a letter on Aug. 23, 1917. Up to November 5 about one-half the local exemption boards had responded to the Governor's request, and as a result nearly 500 cases were brought to the attention of this Department. On that date another circular letter was sent out calling attention to this fact, and stating, further, that in order to better facilitate such reporting the Department was having printed, and would distribute shortly to the exemption boards, a special report card for each individual case, with return addressed envelope. The following table gives a statement of the results of this method of co-operation since the exemption boards commenced their duties. The local boards of health have also rendered valuable assistance to the Department, in its efforts to furnish information to the government, by sending us lists of men certified from their cities and towns, previously recorded as tuberculous.

Summary of Frank or Suspected Cases of Tuberculosis brought to the Attention of the State Department of Health in Connection with the Selective Service Law.

Rejected in examination by local exemption boards,	850
Rejected by recruiting officer of United States Marine Corps,	36
Returned from cantonments other than Camp Devens,	21
Returned from Camp Devens, at Ayer, to this State,	62
Returned from Camp Devens, at Ayer, to other States,	17
Men at Camp Devens reported as having tubercle bacilli,	9
Men discharged from the army,	3
Men in the army reported by local boards of health as suffering with pulmonary tuberculosis,	6
Soldiers reported as having been admitted to tuberculosis hospitals,	2
Total,	1,006

Division of Biologic Laboratories.

Milton J. Rosenau, M.D., *Director and Pathologist.*

Report of the Division of Biologic Laboratories.

There was an unusual demand for biologic products during the fiscal year just ended. For example, 180,521 doses of vaccine virus were distributed, which is much more than during any previous year. The demand for this product increased to such an extent that during three weeks of December, 1917, more vaccine virus was prepared and distributed than normally is put out in five months. This great demand was due to the publicity given to some cases of smallpox which occurred in the Commonwealth.

The increased prevalence of diphtheria throughout the State resulted in an unusual demand for diphtheria antitoxin. In all, 252 gallons of this curative and protective serum, representing 218,603,000 immunity units, were prepared and distributed. This is a marked increase over the amount made and distributed the previous year. For a time it became necessary to discontinue refining and concentrating diphtheria antitoxin, owing to inability to obtain dialyzing paper. All this paper was formerly made in Belgium. Recently a domestic supply was secured, and part of the diphtheria antitoxin again is concentrated.

New products added during the fiscal year were paratyphoid and dysentery vaccines and antipneumococcus serum. The unusual increase in the number and quantity of products distributed made it necessary to practice the strictest economy in order to keep within the limits of the appropriation, particularly in view of the increased cost of materials and labor.

As authorized by an act of Legislature, May 3, 1917, five horses were secured for the production of antipneumococcus serum, and a product of high grade was obtained, which has been used in clinical cases in the treatment of pneumonia. On account of the prevalence of pneumonia and its great public health importance, some experimental work was undertaken to obtain a vaccine which would protect against this infection. It has been shown that an active immunity of high grade may be acquired by injecting killed pneumococci of the most prevalent and virulent types, and that this protection lasts one or two years and probably longer. These encouraging results deserve further attention,

and are sufficiently promising to warrant extensive trials on a large scale.

The demand for antimeningitis serum has again increased this year, from 1,760 doses in 1916 to 2,005 doses in 1917. Each dose represents 15 cubic centimeters of this curative serum. Good clinical results have been reported. We now use 49 different strains of meningococci in preparing our antimeningitis serum. We are also on the watch for new strains that may occur throughout the Commonwealth.

The amount and details concerning the distribution of the Schick toxin, typhoid and paratyphoid vaccines, etc., will be found in the report of the assistant director.

Over 28,000 Wassermann tests were made at a cost of about 20 cents per test. The commercial price of this test is $5. This service has been simplified and improved by opening the tests directly to all institutions and physicians of the Commonwealth.

We continued to co-operate with the Bureau of Animal Industry of the Department of Agriculture with reference to the diagnosis of glanders, rabies, black leg, anthrax and other communicable diseases.

There is evidence that the complement fixation test is an aid in the diagnosis of tuberculosis. It is claimed that the test is especially valuable in the diagnosis of incipient tuberculosis, which is often difficult to make. For these reasons it seemed desirable for the Wassermann Laboratory to undertake an experimental study of this test.

The Division of Biologic Laboratories has co-operated with the government in various ways. Instruction has been given to a government officer detailed to the Wassermann Laboratory for the purpose of learning the Wassermann technique. We have also tested the blood of a large number of aviators, etc.

The work of the Division has been increased, the number of its products multiplied, and the quality of its service improved. This has been possible only through the *esprit de corps* of the personnel, who have again demonstrated loyalty and devotion to the work.

The detailed reports of the assistant directors will be found in the appendix.

Division of Hygiene.

Lyman Asa Jones, M.D., *Director*.

Report of the Division of Hygiene.

Two nurses, Miss Irene Griffin and Miss Blanche Wildes, have been added to the staff, both engaged in connection with child welfare work.

Late in the year Mrs. Alzira W. Sandwall was appointed, in conjunction with the Division of Food and Drugs, as food worker, to prepare articles on food for publication, to speak on the same subject and to do certain laboratory work on foods.

Whether directed toward the conservation of infant life, or toward the promotion of health in early childhood and during school years, or toward the reduction of preventable deaths due to cancer, circulatory diseases and other causes at the middle period of life and later, or whether directed toward the control of communicable diseases at all periods of life, the work of the Division of Hygiene is essentially educational.

The object of its educational work is to make known to the people of the Commonwealth at large the fundamental importance and value of health; to point out the causes of disease; to show how the communicable diseases are spread; to indicate measures and agencies through which the spread of preventable diseases may be controlled and prevented; and to stimulate communities to appropriate funds and to take measures to this end suitable to their individual needs.

The work of this Division is carried on through the following agencies: —

1. Office force necessary to attend to correspondence and usual clerical work connected with arranging for lectures and exhibits and material for same, preparation of reports, material for publication, proofreading and other incidental matters.
2. Field workers; nurses engaged in connection with infant and child welfare work; food expert engaged in work previously mentioned; an expert draftsman engaged partly in field work relating to rural sanitation, and partly in preparation of charts for the use of the Department.
3. Co-operating agencies, through whose efforts it has been possible for the Department to undertake tasks not otherwise within its present means, such as the infantile paralysis after care, given by the Harvard Infantile Paralysis Commission, or the examination of pathological tissues made possible by the offer of the Harvard Cancer Commission.
4. Lecture service and Child Welfare Exhibit.
5. Publications.

1. Work of the Office.

It is unnecessary to mention the office work further than has been indicated above.

2. Field Workers, Nurses, etc.

Infant Mortality Statistics of the Commonwealth of Massachusetts.[1]

Year.	Total Births.	Deaths under One Year.	Infant Mortality Rate.
1910,	86,539	11,499	132.9
1911,	88,327	10,543	119.4
1912,	89,882	10,472	116.5
1913,	91,644	10,086	110.1
1914,	93,399	9,894	105.9
1915,	93,155	9,469	101.6
1916,	93,487	9,326	99.7

[1] Figures in this table taken from records of the Secretary of the Commonwealth.

The efforts of the field workers have been devoted almost entirely to the prevention of infant mortality and the promotion of child welfare.

Two of the nurses have served often as advance agents for the Child Welfare Exhibit, visiting a community to arouse interest and to secure the co-operation of the local board of health and other welfare agencies in planning for the display of the exhibit, and lending assistance in arranging for a lecture program at the time of the exhibit. Later they have accompanied the exhibit and have been in attendance during its display, and have given numerous talks to school children, who were especially invited to attend, and to other groups of people.

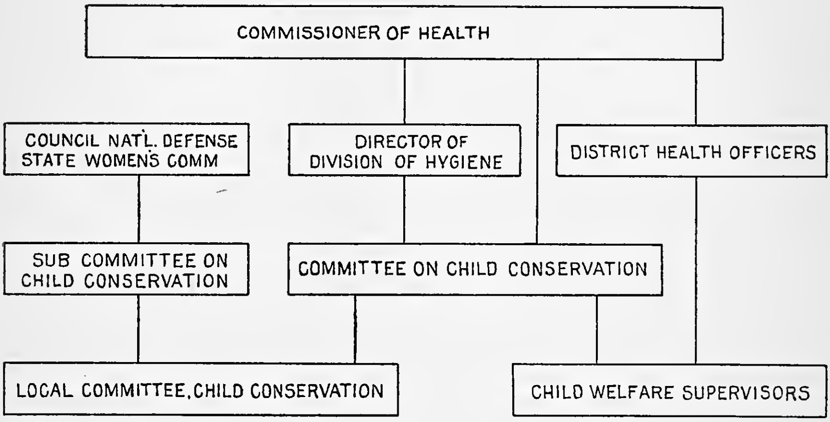
A third nurse, since the middle of the year, has been particularly engaged in studying in detail conditions in selected localities where the infant mortality rate was high, seeking to learn the special causes of the high rate in the community studied, and finally attempting to arouse local interest so that necessary funds might be raised to employ a public health nurse or other worker to meet local needs.

In the furtherance of such efforts the Division has given assistance by providing lectures or the exhibit or both, according to circumstances. A considerable extension of the child welfare work of the Division was made possible through the appointment of a committee on child con-

servation. The scheme of organization of the committee, and its relation to the Department and to local agencies, is shown in the accompanying chart. Its membership and plan of work are given in the Commissioner's report (pages 12 and 13).

COMMITTEE ON CHILD CONSERVATION

SCHEME OF ORGANIZATION



Reports from field workers have been received for the following cities and towns; Cambridge, Chicopee, Dracut, Fall River, Fitchburg, Holyoke, Lowell, Lynn, Malden, Marlborough, Montague, Newton, Provincetown, Weymouth and Worcester, 16 in all.

The Department was represented at the meeting of the American Association for the Study and Prevention of Infant Mortality in Richmond, Va., and at the meeting of the American Public Health Association in Washington, where accounts of its infant mortality work were given.

A summary of the present status of school hygiene work in Massachusetts was completed and published in the November Public Health Bulletin. The study makes it plain that supervision of this work is necessary, that there should be authority to establish minimum standards for such work, and that provision should be made for extending the work to include private and parochial schools as a health measure. Further consideration of the subject may be found in the article itself, available as a reprint, upon application.

3. Co-operating Agencies.

Harvard Infantile Paralysis Commission.

An account of the plan whereby emergency clinics for the after care of infantile paralysis cases were provided in co-operation with the Harvard Infantile Paralysis Commission appeared in the preceding annual report. Such clinics maintained jointly by the Department and by the commission were held during the first half of the year in Beverly, 2; Greenfield, 2; Lawrence, Lowell, Lynn, 2; Malden, Melrose, Newburyport, 2; North Adams, Quincy, 2; Springfield, 4; and Worcester, 2; a total of 21 clinics, at which 783 patients were seen.

Since June 1 the work has been carried on by the commission, assisted by local boards of health and private subscriptions. The Department has continued in close touch with the work, and has co-operated through its District Health Officers in assisting to arrange for clinics which have been held in Haverhill, Lawrence, Lowell, Melrose, North Adams and Springfield. At these clinics 235 patients were cared for.

The clinic at the Children's Hospital has been continuously maintained by the commission on three days each week. Further information may be found in statements issued by the commission.

Harvard Cancer Commission.

Through the acceptance of an offer of the Harvard Cancer Commission the Department has been able to extend to the registered physicians of the State in September an opportunity for the examination and diagnosis of pathological tissues. Outfits for the submission of specimens were provided and may be obtained from the District Health Officers. The following announcement of this service was made through the Public Health Bulletin and through the public press. Some 60 specimens have already been submitted for examination.

Free Diagnosis of Pathological Material.

The State Department of Health takes pleasure in making the following announcement, made possible through the kindly offer of the Cancer Commission of Harvard University.

On and after Oct. 1, 1917, with the co-operation of the Cancer Commission of Harvard University, the State Department of Health of Massachusetts will be able to offer to the registered physicians of the State the opportunity for the free diagnosis of pathological material removed at operation. This service is already provided in a number of States by the laboratories of State universities or by the departments of public health. It is believed that a material decrease

in the number of advanced and inoperable cases of cancer, and a considerable increase in the accuracy of diagnosis of cancer and other tumors, will result from the institution of this service.

Specimens submitted for examination will be received at the laboratory of the Cancer Commission, at the Medical School of Harvard University, Longwood Avenue, Boston. This service will be under the direction of Prof. James Homer Wright, M.D., S.D., pathologist of the Massachusetts General Hospital. Reports will be forwarded by mail or telegram to the attending physician.

The practice of cutting through sound tissue into cancer tissue in order to remove a fragment for subsequent microscopic examination is generally condemned, on the ground that such a procedure leads to a rapid spread of the disease, and usually deprives the patient of his one chance of cure by radical operation. When doubt exists as to the nature of the tumor which is deeply placed, after all other resources of diagnosis, such as the X-ray, the Wassermann reaction, the blood examination, and competent consultation have been exhausted, the resources of some hospital or institution equipped for immediate frozen section diagnosis should be sought, and the operation should be completed under one anæsthesia. Thus lesions which are suspected to be malignant may be divided arbitrarily into two groups, as follows: —

Group 1. — Lesions which are superficial or ulcerated, as those of the external skin, the mouth, tongue, palate, larynx, œsophagus, rectum, bladder and cervix of the uterus. In such cases the whole lesion should be removed in preference to cutting into the suspected tissue. Where total removal would cause so much mutilation as to be unjustified on a doubtful diagnosis, facilities for a frozen diagnosis should be obtained in order that the radical operation may be completed immediately if malignant disease is discovered. The cautery should be used in these cases to seal the lymphatics while waiting for the report of the pathologist. This caution applies also to suspected carcinoma of the body of the uterus, and immediate frozen section diagnosis of the material obtained with the curette should be made available, and the radical operation, if necessary, performed under one anæsthesia. In but few cases is the exploratory removal of a fragment of tissue to be sent for a subsequent pathological examination justified. When no other recourse is open to the physician, however, the specimen should be removed with the cautery, or the cautery should be used immediately to seal the tissue spaces.

Group 2. — Lesions which are deeply placed, and covered by sound tissue, as those of the breast, the salivary glands, thyroid, stomach, intestine, gall bladder, kidney, ovary, testicle and tumors of the subcutaneous tissues, lymph nodes, bones, fasciæ and muscles. In such cases the exploratory incision into the suspected tumor tissue is *never* justified unless the frozen section diagnosis is available, and even then the radical operation, without exploratory incision, is usually safest for the patient. Especially is this true in the case of tumors of the breast.

Benign tumors and diseases which are recognized as particularly liable to malignant development should be removed entire, and the tissues submitted for confirmation of the diagnosis by pathological examination. Among these condi-

tions may be included the benign tumors and chronic diseases of the breast, ovarian cysts, papillomata of the rectum and anus, polyps of the uterus, rectum and larynx, and pigmented moles, nævi, warts, fissures and chronic ulcerations of the external skin, especially those which show a tendency to ulceration, bleeding or gradual increase in size.

Containers and full directions for the preservation and shipment of specimens for diagnosis may be obtained from the State District Health Officer. These officers are stationed as follows: —

Dr. Adam S. MacKnight, 355 North Main Street, Fall River.
Dr. Merrill E. Champion, 50 Phillips Street, Wollaston.
Dr. Arthur A. Brown, Willey House, Swampscott.
Dr. Charles E. Simpson, 100 Holyrood Avenue, Lowell.
Dr. George T. O'Donnell,[1] 768 Main Street, Waltham.
Dr. Francis A. Finnegan, 14 Longwood Avenue, Fitchburg.
Dr. John S. Hitchcock, 160 Main Street, Northampton.
Dr. Howard A. Streeter, 740 Dalton Avenue, Pittsfield.

A card will be provided which must be filled out by physicians desiring to avail themselves of this service. Reports will go in duplicate to the physician and to the Health Officer of the District, and any questions raised by the pathological report will be discussed by letter or by personal interview with the Director of the State Diagnosis Service during his office hours, Monday, Wednesday and Friday, 4 to 5 P.M., Cancer Commission, Medical School of Harvard University, Building E, Longwood Avenue, Boston.

4. Lecture Service and Child Welfare Exhibit.

Several factors have contributed to make the lecture service less extensive than last year. The chief influence, however, has been the absorption of people in activities connected with the present war. Throughout the year Red Cross work has been increasingly taken up, while during the summer, which is also the vacation season, and during the fall, especially in the rural sections, farm and garden activities, vigorously pushed because of war conditions, left little time for the consideration of other matters.

Notwithstanding, 451 lectures have been given by those associated with the Department, with an aggregate attendance of approximately 60,000; 130 of the lectures, given chiefly by the nurses, in connection with the Child Welfare Exhibit, were attended by more than 25,000 school children.

During the year additional lantern slides have been added to the collection already owned by the Division. Effort is made to add new or better slides and to secure slides illustrating Massachusetts conditions where possible, since, as a rule, home material is more impressive than similar material depicting conditions remote or unfamiliar.

[1] Temporary Acting State District Health Officer.

Two balopticons and one acetylene lantern are in frequent use for illustrating lectures when local projecting apparatus is unavailable.

In June, within four days, a series of nine lectures was given in a group of hill towns, largely places away from lines of transportation. Schools and social organizations were visited. The talks were given by Mr. Williams, who made use of slides in connection with his talks. In October a similar series was given by Mr. Williams in some of the same towns, in response to urgent requests by interested residents.

For such remote or isolated sections a similar grouping and arranging for a series of health talks would seem to offer an excellent opportunity for spreading knowledge as to health, and any requests of this nature will be gladly entertained.

Late in the year much attention was given to the preparation of venereal disease material for a leaflet and for lecture use. A request was received from the War Department at Washington that the Department should deliver lectures upon this subject, with compulsory attendance, at the military cantonment at Ayer. Owing to some confusion at Washington, the lectures at this time were given under Y. M. C. A. auspices. It is understood that subsequent lectures will be given by this Department.

Details showing the distribution and attendance of lectures by months, the names of the communities where lectures were given, and the subjects discussed may be found in the accompanying tables.

Lectures were given during the year ended Nov. 30, 1917, as follows: —

Month.	Lectures.	Number Present.
1916.		
December,	21	5,112
1917.		
January,	39	3,447
February,	36	5,709
March,	57	10,101
April,	51	8,452
May,	68	9,575
June,	46	5,013
July,	12	363
August,	9	2,135
September,	22	935
October,	32	3,188
November,	58	5,209
Total,	451[1]	59,239

[1] There were 130 lectures given before school children.

Lectures were given in the following communities during the fiscal year ended Nov. 30, 1917: —

Abington,	1	Grafton,	1
Adams,	10	Great Barrington,	1
Agawam,	1	Greenfield,	5
Alford,	1	Groton,	5
Allston,	1	Groveland,	1
Amherst,	3	Hadley,	3
Ashfield,	3	Hancock,	2
Ayer,	8	Hanover,	1
Bangor, Me.,	1	Hardwick,	1
Belchertown,	1	Haverhill,	2
Belmont,	1	Hinsdale,	1
Berlin,	3	Holden,	1
Beverly,	1	Holliston,	2
Blackstone,	7	Hubbardston,	1
Boston,	53	Lancaster,	1
Braintree,	1	Lawrence,	2
Bridgewater,	2	Lee,	8
Brockton,	3	Leicester,	1
Brookfield,	1	Leominster,	15
Cambridge,	7	Lexington,	1
Canton,	1	Lincoln,	1
Chelsea,	1	Lowell,	5
Chicopee,	4	Ludlow,	4
Clinton,	4	Lynn,	5
Cohasset,	1	Malden,	2
Colrain,	1	Mansfield,	2
Concord,	1	Marblehead,	1
Concord, N. H.,	2	Marion,	1
Cummington,	4	Marlborough,	2
Danvers,	1	Maynard,	3
Deerfield,	1	Merrimac,	1
Dennis,	1	Methuen,	1
Dighton,	1	Millbury,	2
Easton,	3	Montague,	14
East Bridgewater,	4	Monterey,	1
Everett,	1	Natick,	6
Fairhaven,	1	New Bedford,	3
Fall River,	5	Newburyport,	1
Fitchburg,	2	Newton,	2
Framingham,	1	Newtonville,	1
Freetown,	1	Northampton,	7
Gardner,	1	North Adams,	13
Goshen,	2	North Andover,	1

North Reading,	3
Norwood,	1
Orleans,	2
Otis,	1
Peabody,	1
Pembroke,	2
Pepperell,	8
Pittsfield,	18
Plainfield,	3
Plympton,	1
Princeton,	1
Provincetown,	4
Quincy,	7
Randolph,	2
Reading,	1
Richmond, Va.,	1
Rockland,	7
Rowe,	1
Rowley,	1
Rutland, Vt.,	2
Saugus,	13
Shelburne,	2
Southbridge,	6
Somerville,	1
Springfield,	4
Stockbridge,	1
Stoneham,	9
Taunton,	1
Templeton,	1
Townsend,	2
Wakefield,	3
Waltham,	1
Washington, D. C.,	1
Watertown,	1
Wayland,	1
Webster,	7
Westborough,	1
Westfield,	10
Westford,	1
Westhampton,	1
Westminster,	1
West Newbury,	1
Weymouth,	5
Whitman,	1
Williamsburg,	1
Winchendon,	10
Windsor,	1
Wollaston,	1
Worcester,	3
Worthington,	1
Wrentham,	1
	451

Subjects covered in the lecture service are given below.

Lectures on food and drug subjects,	41
Lectures on tuberculosis,	26
Lectures on school hygiene,	37
Lectures on wear and tear diseases, etc.,	10
Lectures on rural sanitation,	14
Lectures on public health,	52
Lectures on public health nursing,	23
Lectures on child hygiene,	190
Lectures on communicable diseases,	46
Lectures on mosquitoes,	2
Lectures on oral hygiene,	1
Lectures on poliomyelitis,	1
Lectures on Red Cross activities,	4
Lectures on quackery,	1
Lectures on preparedness,	3
	451

The Child Welfare Exhibit has been displayed 36 times in 33 communities, with a total estimated attendance of 60,000. In cities and towns where the exhibit was shown especial effort was made to secure the attendance of children.

At the time of the exhibit arrangements were made, if possible, for the display of the Division's moving-picture health reels, either in connection with the exhibit itself or at some local moving-picture theatre. The various films were loaned in this manner 378 times. In many instances they were used more than once in an individual place, but of the exact number of times a given film was shown there is no record.

One of the tuberculosis films, much worn, was replaced, and all of the films were renovated.

During the early fall the Child Welfare Exhibit was shown at ten of the agricultural fairs. A tent was purchased in which to house the exhibit, since in but one instance was it possible to secure display space in the main exhibition hall.

Because it was desired to reach communities where the exhibit had not been previously shown, some of which were away from lines of direct communication, arrangements were made for the transportation of the tent and exhibit by auto truck. The exhibit attracted much attention. Two of the nurses were present to explain the charts and panels. The success of the exhibit in many localities was greatly promoted by the active co-operation of local boards of health, women's clubs and other interested individuals.

A list of the moving-picture films shown, and of places where the exhibit was displayed, follows.

The moving-picture films were in use as follows: —

	Times
Fly Danger,	54
Toothache,	53
Bringing it Home,	52
The Price of Thoughtlessness,	50
The Temple of Moloch,	38
The Great Truth,	41
The Long *versus* the Short Haul,	30
The Price of Human Lives,	33
In his Father's Footsteps,	27
	378

The Child Welfare Exhibit was shown in the following communities: —

- Adams.
- Ayer.
- Blackstone.
- Boston.
- Chicopee.
- Groton.
- Hadley.
- Lee.
- Leominster.
- Ludlow.
- Maynard.
- Montague (Millers Falls; Turner's Falls).
- Northampton.
- North Adams.
- Pepperell.
- Pittsfield.
- Saugus.
- Southbridge.
- Springfield.
- Stoneham.
- Webster.
- Westfield.
- Winchendon.

At fairs in the following places: —

- Barnstable.
- Charlemont.
- Cummington.
- Great Barrington.
- Marshfield.
- Middlefield.
- Palmer.
- Sturbridge.
- Uxbridge.
- Weymouth.
- Worcester.

5. Publications.

Aside from the annual report the largest other undertaking in publications had to do with the printing of "The Food of Working Women in Boston," an investigation by the Department of Research, Women's Educational and Industrial Union, Boston, in co-operation with the State Department of Health. The investigation was supervised by Dr. Lucille Eaves of the Educational and Industrial Union. Copies of this report are available for distribution on request.

An edition of 60,000 copies of the booklet "The Baby and You" was ordered, and through the co-operation of local boards of health the plan of sending a copy to each home from which a birth was reported was continued through the year. Expressions of appreciation have been received from time to time, and as a further evidence of its usefulness it has been copied practically in whole or in part by some other health departments.

The leaflet "For Mothers with Little Babies" continues in demand, especially the copies in foreign languages. New editions in Polish, Yiddish, Portuguese and Greek were ordered during the year.

Prenatal Letters. — Following a plan successfully employed by the Kansas State Department of Health, a series of nine prenatal letters, largely based on a similar series written by Dr. Lydia DeVilbiss for the Kansas Department, was prepared, and in October announcement was made that these letters would be sent, one each month, to expectant mothers who might apply for them, either directly or through their physician, visiting nurses, etc. About 200 applications have already been received, and in addition many specimen sets have been distributed in response to requests.

Specimen sets may be obtained upon application to the Department.

Reprints of various articles appearing in the Public Health Bulletin during the year have been secured for general distribution. The list includes articles on "Cancer," "Prevention of Flies," an article on "Nuisances and Boards of Health," chiefly containing an address by James J. Ronan, Esq., of Salem, delivered at a meeting of the Association of Boards of Health of the Northeastern District held in Lynn on April 11, 1917; "Minimum Rules for Communicable Diseases," "Sanitary Organization of Zone about the Military Camp at Ayer, Mass.," and the "Résumé of the Present Status of Medical Inspection in Schools in Massachusetts," previously mentioned.

A new leaflet concerning lectures and moving-picture films was prepared. Additional copies of the Health Creeds have been printed to meet the continued demand for the same.

Report of the Board of State Examiners of Plumbers.

James C. Coffey, *Chairman.*

Report of the State Examiners of Plumbers.

Information concerning Examinations for Plumbers, showing the Place and Date of Examination and Number examined, together with the Results of the Examination, etc.

Examinations.	Examined.	Passed.	Refused.
Boston, Dec. 2, 1916,	61	13	48
Lowell, Dec. 16, 1916,	39	4	35
Boston, Jan. 6, 1917,	81	8	73
Pittsfield, Jan. 20, 1917,	23	5	18
Boston, Feb. 3, 1917,	99	20	79
Springfield, Feb. 17, 1917,	52	12	40
Boston, March 3, 1917,	107	29	78
Fall River, March 17, 1917,	40	9	31
Boston, April 7, 1917,	98	21	77
Worcester, April 21, 1917,	51	13	38
Boston, May 5, 1917,	95	23	72
Lowell, May 19, 1917,	33	8	25
Boston, June 2, 1917,	92	26	66
Pittsfield, June 16, 1917,	32	6	26
Boston, July 7, 1917,	89	17	72
Boston, July 21, 1917,	74	10	64
Boston, Sept. 1, 1917,	73	3	70
Springfield, Sept. 16, 1917,	24	6	18
Boston, Oct. 6, 1917,	64	9	55
Fall River, Oct. 20, 1917,	18	1	17
Boston, Nov. 3, 1917,	38	4	34
Worcester, Nov. 17, 1917,	17	5	12
Totals,	1,300	252	1,048

	Masters.	Journeymen.	Total.
Licenses granted on account of examination, Dec. 1, 1916, to Dec. 1, 1917,	58	194	252
Probationary licenses issued during the year,	-	-	11

Registrations.	Masters.	Journeymen.
December, 1916,	-	3
January, 1917,	4	3
February, 1917,	-	1
March, 1917,	1	2
April, 1917,	2	1
May, 1917,	1	1
June, 1917,	1	3
July, 1917,	-	-
August, 1917,	-	1
September, 1917,	-	3
October, 1917,	-	1
November, 1917,	-	2
Totals,	9	21

Meetings,	67	Examinations,	22

Fees received.	Paid to the Treasurer of the Commonwealth.
1,300 examination fees, at $0.50,	$650.00
75 master plumber licenses issued, at $2.00,	150.00
221 journeyman plumber licenses issued, at $0.50,	110.50
1,739 master plumber renewals issued, at $0.50,	869.50
4,041 journeyman plumber renewals issued, at $0.50,	2,020.50
119 back fees received, at $0.50,	59.50
Total.	$3,860.00

For carrying out the Provisions of the Act relative to the Examination of Plumbers.

Salary of secretary,	$2,000 00
Examiner's wages,	603 25
Traveling,	459 66
Express,	30 31
Printing,	112 80
Postage,	141 86
Books and stationery,	46 07
Plumber's materials,	50 54
Extra services,	1,134 99
Cleaning,	27 20
Office supplies,	9 00
Miscellaneous,	1 25
Telephone and lighting,	80 54
Typewriter supplies and repairs,	25 00
Labor and materials,	7 40
Total,	$4,729 87

Summary of Registrations.

	Masters.	Journeymen.
Certificate holders,	480	483
Licenses, year ending May 1, 1917,	1,775	4,102
Totals,	2,255	4,585

Deceased Plumbers (reported to Examiners).

Masters,	22	Journeymen,	19

Respectfully submitted,

JAMES C. COFFEY.
DAVID CRAIG.
CHAS. R. FELTON.

APPENDIX.

Division of Sanitary Engineering.

DIVISION OF SANITARY ENGINEERING.

WATER SUPPLY AND SEWERAGE AND PROTECTION OF INLAND WATERS.

WATER SUPPLIES.

Very little water works construction has been done during the past year, and no new public water supplies have been introduced. Of the 354 cities and towns in the State, 212, having an aggregate population in 1915 of 3,527,419, are provided with public water supplies. The population in 1915 of the remaining towns not yet provided with public water supplies was 165,891, an average of less than 1,200 inhabitants per town. However, 22 of these towns had a population in excess of 2,000, as follows: —

Tewksbury,	5,265	Wilbraham,	2,521
Warren,	4,268	Dighton,	2,499
Templeton,	4,081	Acushnet,	2,387
Somerset,	3,377	Wilmington,	2,330
Auburn,	3,281	Rehoboth,	2,228
Westport,	3,262	Charlton,	2,213
Sutton,	2,829	Harwich,	2,179
Seekonk,	2,767	Belchertown,	2,062
Bourne,	2,672	Georgetown,	2,058
Hanover,	2,666	Upton,	2,036
Swansea,	2,558	Millville,	2,010

RAINFALL AND FLOW OF STREAMS.

The normal rainfall in Massachusetts, as deduced from long-continued observations in various parts of the State, is 44.54 inches. The average rainfall in the State for the year 1917 was 40.23 inches, or 4.31 inches below the normal. The precipitation exceeded the normal in the months of March, May, June, August and October,

while in the other months there was a decided deficiency, especially in the months of July, September and November.

The flow of the Nashua River for 1917 was one of the lowest recorded in the twenty-one years during which observations of the flow of that stream have been made. The flow of streams, judging from the flow of the Nashua River, was less than the normal in all the months excepting May, June and October, the only notable excess occurring in the month of June. Owing to the distribution of the rainfall, and especially the high rainfall in the late spring and in August and October, public water supplies were well maintained and no serious shortage was noted in any part of the State.

Sanitary Protection of Public Water Supplies.

Very little difficulty has occurred during the year in the sanitary protection of public water supplies, though cases have arisen in which it has been sought to use a watershed devoted to water supply purposes for the purposes of playgrounds, public parks, etc. There may be little harm in some cases in providing driveways through a watershed, since traffic is now largely carried on by automobile, and the presence of a highway in some of the watersheds close to populous areas may be in some degree a protection rather than an injury, but there can be no question that throwing open the water supplies for use for boating, fishing, etc., constitutes a most serious danger to the purity of such supplies. There has been considerable pressure during the past year for the opening of some of the public water supplies to fishing for the sake of increasing the food supply. The quantity of food obtainable in this way is very small and the quantity actually obtained, so far as has been learned, in places where fishing has been allowed, is negligible. Since little or nothing is to be gained in an economic way and the danger of injury to the public health is great, fishing in public water supplies should be prevented. A case brought in the courts for preventing the cutting of ice on a source of public water supply is pending.

Water Supply of the City of Lawrence.

In view of the difficulty experienced in operating the filters of the water supply of the city of Lawrence in winter, the work of covering the old filters was begun in 1916 and a part of the work has already been completed. Not enough has been done, however, to insure an adequate water supply for the city, and auxiliary supplies are obtained

from Andover and North Andover. Early in 1917 a committee was appointed by the city to consider the whole question of water supply, and the investigations were in progress during the remainder of the year.

Salem and Beverly Water Supply.

The cities of Salem and Beverly completed works in 1917 for supplementing the water supply of those cities in Wenham Lake with water pumped from the Ipswich River in the winter season, when the flow exceeds 20,000,000 gallons per day. Under the restrictions imposed on the use of water from the Ipswich River, it is impracticable to obtain any water therefrom during the six months from June to November, inclusive, and during this period of the year the water in the lake is likely to be drawn to a very low level in a dry season. The Department in its report dated Jan. 10, 1917, recommended that it be authorized to investigate and determine whether the surplus flow of the Ipswich River in the summer months might be used for the supply of these cities without detriment to other interests. An appropriation was made for this work, but the amount provided was found to be wholly inadequate for the purpose. It is recommended that an additional sum which will bring the total appropriation up to $1,500 be provided for this work.

Water Supply of Southeastern Massachusetts.

There is a large district in southern Bristol and Plymouth counties, comprised chiefly within the watershed of the Taunton River and of certain small watersheds adjacent thereto draining southerly into the sea, the future water supply of which appears to require careful consideration at the present time.

This district contains the cities of New Bedford, Fall River and Taunton, which, with the population of adjacent municipalities now or likely to be dependent upon them for water supply, had a population in 1915 of nearly 300,000. The population has grown steadily and quite rapidly in recent years, and, judging from the growth of cities with similar industries in other countries, the population of this district is likely to grow even more rapidly in the future than it has in the past.

Throughout the greater part of this region the conditions for obtaining municipal water supplies in large quantity and with reasonable economy are quite unfavorable. The streams for the most part flow with sluggish current through wide, flat valleys occupied largely by

swamps, and the contour of the ground is unfavorable for the construction of reservoirs of large capacity suitable for the storage of water for municipal uses. On the other hand, the region contains two groups of remarkable natural storage reservoirs, one, the Lakeville ponds, so called, in the watershed of the Nemasket River, covering an aggregate area of 5,867 acres, and the other, the Watuppa ponds, covering an area of 4,337 acres, situated in the city of Fall River. From the former group of lakes, the cities of New Bedford and Taunton obtain their water supplies at the present time, while the northerly part of the latter group supplies the city of Fall River. For the protection of their water supplies, these cities have from time to time acquired lands about their sources which now amount in the aggregate to a very large area; but while some of the sources are well protected in this way, others reamain open to settlement, and unless control of these sources is secured at the present time, it may be impracticable to protect them thoroughly in the future at a reasonable cost.

Under these conditions municipalities might be forced to use polluted or otherwise inferior waters, depending for the improvement of such waters and for the protection of the public health upon filtration and such treatment as may be found necessary, or it may be necessary to supply water in these regions from other sections of the State. It is also desirable to deter mineunder what limitations, if any, these areas can continue for a time at least to be used by the public for boating and fishing and such other purposes as may be desired by the public in general.

In view of these circumstances, it is recommended that an investigation be made of the general subject of water supply in this region, with a special consideration of the extent to which the Lakeville and Watuppa ponds should be further protected and developed for municipal purposes, the probable cost of such protection, and the extent of the practicable development of these sources.

Examination of Domestic Water Supplies.

Under the provisions of chapter 90 of the Resolves of 1917, the State Department of Health was authorized to make a sanitary examination of waters used for domestic purposes and obtained from other than public water supplies, including a chemical and bacterial analysis of the water when necessary. The Department was also required to advise as to the location of new domestic water supplies and the protection of such supplies in a manner similar to that now employed in the examination of public water supplies.

Acting under authority of that resolve, the Department gave notice

that applications would be received for the examination of individual water supplies during the summer season. Great interest was at once manifested in this work and 69 applications were received for advice as to domestic water supplies in the short period in which it was announced that such applications would be received. This number is about one-half the number of applications as to water supply and sewerage, etc., ordinarily received by the Department, though of course the work required in each case is much less than in the consideration of a water supply or sewerage system for a city or town. It was not practicable, however, during the present year to examine all of the sources for which application was made. Of the 69 applications which were received, the examination of 45 has already disclosed a considerable number of badly polluted private water supplies in regular use. From the experience of the past summer it is evident that much valuable work can be done in the protection of the public health by the examination of private water supplies. This work is especially important in thickly settled communities where there is no public water supply, and the appropriation made available for this purpose has been of great value in examining private water supplies in the neighborhood of military camps, in co-operation with the military authorities.

Water Supply and Sewerage of Military Camps.

The construction and occupation of Camp Devens at Ayer during the summer involved the installation of water supply and sewerage systems for 30,000 to 40,000 inhabitants. The water supply for the camp was obtained from a large well located on the southerly side of the mill pond on Nonacoicus Brook near the village of Ayer. The water is clear, colorless, soft, and of excellent quality for domestic uses. The supply can doubtless be supplemented by additional wells in the neighborhood if more water is required than was deemed necessary when the works were built. The camp is also provided with a system of sewerage by which the sewage is collected from all the buildings in the grounds in a system of pipe sewers and conveyed to a pumping station located in the valley of Nonacoicus Brook near the Nashua River, from which it is to be pumped to filter beds near the east bank of the river about $1\frac{1}{4}$ miles northwest of Ayer.

The location selected is a high tableland in an uninhabited section of Ayer which contains soil of excellent quality for the disposal of sewage by intermittent filtration. Twenty acres of filter beds have been provided for the disposal of the sewage of the camp, and the works were nearly completed at the end of the year.

Water supply and sewerage systems have been provided for a number of small camps in other parts of the State, and considerable work has also been done by the Department in co-operation with military and naval officials relative to the selection of water supply and sewerage systems for these camps, as well as in determining the condition of private supplies, the use of which might affect the health of a camp.

Examination of Sewer Outlets discharging into the Sea.

Many of the sewer outlets discharging into the sea or tidal waters have been examined as usual during the year, and no changes worthy of note have been found in the conditions about any of these outlets. The new outlet for the north metropolitan sewerage system at Deer Island was completed and first operated in November, 1917. This outlet seems likely to prove a most satisfactory one. The sewage disposed of at this outlet is now discharged from fourteen openings in a conduit 126 feet long, laid on the bottom of the sea 32 to 53 feet below low water, in extension of the former outlet and at right angles to the strong tidal current which passes this point.

No important changes have been made in other sewer outlets during the past year. The sewer outlet of the city of Lynn continues to be the most objectionable of those which discharge into the sea; but owing to existing conditions, it has not been deemed practicable to attempt to make a change at this outlet at the present time in accordance with the recommendation of the Joint Board in 1916 (Senate Document, No. 450, 1916).

Changes are very desirable in the outlets of the sewage of the city of Beverly and of the cities of Salem and Peabody, and a sewerage system is greatly needed in the town of Danvers to remove the sources of pollution of local waters in that town, but under the existing conditions it has been found necessary to postpone these improvements.

Sewage-disposal Systems.

The following is a list of the principal sewage-disposal works now in operation in the State: —

Amherst.	Billerica.
Andover.	Brockton.
Attleboro.	Clinton.
Ayer (Camp Devens).[1]	Concord.

[1] Completed at end of year.

Easthampton.
Fitchburg.
Framingham.
Franklin.
Gardner.
Hopedale.
Hudson.
Leicester.
Lenox.
Longmeadow.
Marion.
Marlborough.
Maynard.
Medfield.
Milford.
Natick.
North Attleborough.
Northbridge.
North Brookfield.
Norwood.
Pittsfield.
Southbridge.
Spencer.
Stockbridge.
Westborough.
Worcester.

Additional filters have been constructed during the past year at Andover and Stockbridge to meet the growing needs in those towns.

At Brockton the filter beds have been maintained in satisfactory condition, but much sewage has been discharged into the Salisbury Plain River on account of lack of adequate pumping facilities.

There has been some deterioration in the efficiency of the filters at Clinton, due largely apparently to an increase in the quantity of sewage, and especially in the quantity of manufacturing waste discharged into the sewers.

The sewage-disposal works at Milford have become inadequate for the disposal of the quantity of sewage now discharged from the town, and, in consequence, considerable quantities of unpurified or imperfectly purified sewage are discharged into the river. The offensive conditions caused by the inadequate siphon on the main sewer have not yet been removed.

The filtration works at Natick, Northbridge and Norwood also require enlargement to meet the growing needs of those towns.

The Department has carefully studied the conditions at Southbridge, at the request of the sewer commissioners of that town, during the past year, and has recommended enlargement and improvement of the filtration works.

Good results were secured during the past year at Pittsfield with the enlarged area of filters recently put into use, and the results at Marlborough and Westborough, where the works have recently been enlarged, have also been satisfactory. Among the new disposal works those at Franklin are giving excellent results and relieve Mine Brook and Charles River of much pollution.

A decided improvement has also been made at Framingham in the maintenance and operation of the filters.

Among the most seriously objectionable conditions caused by inadequate filtration works are those at Easthampton, where the sewage of the town has caused the serious pollution of the Manhan River during the past year. Plans for disposing of this sewage into the Connecticut River have already been made by the town and should be carried out at the earliest practicable time.

There have been no material changes at the other works included in the above table.

Sewage Disposal in the Nashua River Valley.

The Legislature of 1917, in response to the recommendation of this Department, authorized the city of Leominster to borrow money for the purposes of constructing a sewage-disposal system. Plans for experimental works only have been prepared by the city, but these works had not been completed at the end of the year. The sewage continues to pollute the Nashua River, on the bank of which in Ayer is situated the principal military camp in New England, and this pollution constitutes a most objectionable condition, in view of the circumstances.

It is important, for the protection of the public health in this region, especially under the present circumstances, that these works should be constructed at the earliest practicable time. In view of the fact that the city of Fitchburg has already constructed works for sewage disposal, and that an excellent plant has been provided for the disposal of the sewage at the military camp, there seems to be no good reason why the sewage of the city of Leominster should still be allowed to continue to be a menace to the health of this region.

One of the tributaries of the Nashua River flowing through the town of Ayer is also polluted by sewage from the latter town. The quantity of sewage discharged into the stream has been small, though in connection with the work of the Department in securing the removal of sewage from the Nashua River and its tributaries the town was urged to build a sewerage system several years ago. It is evident that this town is growing rapidly and a sewerage system has been needed badly for some time, both for the purpose of maintaining proper sanitary conditions in the village itself and for the purpose of removing pollution from the stream in the village. The danger from this pollution is a serious one on account of the great population now living in this neighborhood.

A sewerage system for the portion of the town of Ayer which needs sewerage at the present time would not be an extensive one, and, in

view of the circumstances, it is recommended that provision be made for the construction of a system of sewerage for the central portion of the town of Ayer during the coming year.

Sewerage of the City of Worcester.

The city of Worcester in the early part of 1917 constructed an experimental works for the purpose of making experiments upon the treatment of the sewage of the city by the activated sludge process, so called, and these works have now been in operation for several months, beginning in July. So far as they have progressed, the results have shown that it is practicable by this method to remove a very large part of the organic matter from the sewage, and they indicate that such a works conducted in connection with the present sewage filters would effect a great improvement in the character of the sewage and effluent now discharged into the Blackstone River from the sewage treatment works of the city of Worcester. The experiments show, however, that the cost of maintenance and operation will be large on account of the cost of aeration, making it very desirable to secure if practicable a return for the sludge to offset to some extent the cost involved. The quantity of sludge produced is considerable and is thought to have value as a fertilizer base.

The problem of dealing with the sludge appears to be an important consideration in this process and is one which is likely to require considerable time for its satisfactory solution. So far as determining whether the activated sludge process is adapted for the treatment of the sewage of the city of Worcester, it will probably not be necessary to conduct experiments beyond the end of the present winter, and it should be practicable very soon to determine the comparative cost of disposing of the sewage of the city of Worcester by this method and disposal by trickling filters already considered by the city.

The question as to the best method to employ in the circumstances will depend largely on the comparative economy of the two methods. If one method shows a decided economy as compared with the other, the advantage in this respect might be great enough to justify its selection, since the results obtained by each method properly carried out, utilizing the available portions of the present works, are unlikely to show a material difference, so far as can now be foreseen.

Condition of Rivers.

The condition of the various rivers has been examined as usual during the year, and the following is a brief statement of the condition of each: —

Assabet River.

The most serious pollution of the Assabet River is that which is caused in the town of Maynard by sewage and especially manufacturing waste from the extensive manufacturing establishment in that town.

The investigations during the past year indicate that the pollution of the river at Maynard has greatly increased, a condition which appears to be due in part to the fact that such works as have already been established for treating manufacturing wastes were not operated as effectually as in previous years. Additional works are essential for the proper treatment of the wastes.

Charles River.

The Charles River below Milford has been more seriously polluted in 1917 than for several previous years. This condition is due chiefly to the inefficient operation of the sewage-disposal system of the town of Milford and the consequent discharge of an objectionable effluent into the river. It is important that the condition of these filters be improved and made satisfactory at the earliest practicable time.

Farther down stream the condition of the river through Needham, Dedham and Newton shows little change as compared with previous years.

Chicopee River.

The chief pollution of the Chicopee River and its main tributaries, the Quaboag, Ware and Swift rivers, is the sewage of cities and towns along these streams. The Quaboag River is used as a place of disposal for the sewage of Palmer, a short distance above the mouth of the river, where the conditions thus far have not been found seriously objectionable.

The Ware River, on the other hand, is badly polluted below Ware; and unless the sewage of the town, including some of the more objectionable manufacturing wastes, is removed, this river will become a more serious nuisance.

The condition of the Swift River is not objectionable at present, and the Chicopee River below the confluence of its three principal

tributaries, though receiving the sewage of Ludlow and a part of that of Wilbraham and of the city of Chicopee, has shown little evidence of serious pollution during the present year. A serious nuisance has existed, however, at the outlet of the Chicopee River where it joins the Connecticut, due to the breaking of the main sewer outlet of the city of Chicopee.

Concord and Sudbury Rivers.

The most objectionable pollution of the Sudbury River is at Saxonville, where the condition of the river has been more objectionable than for several years.

The Concord River above Billerica has not been objectionable at any point during the past year. In the course of its flow through North Billerica and the city of Lowell the river receives much pollution, and its condition there will inevitably grow worse unless measures are taken to restrict its pollution.

Connecticut River.

The Connecticut River receives considerable pollution before it enters the State, and the stream at this point has contained in 1917 a somewhat greater quantity of organic matter than it has for several years. Throughout the remainder of its course the condition of the river has been about as usual.

Deerfield River.

The Deerfield River receives very little pollution throughout its course, the most important being the discharge of sewage at Shelburne and Greenfield. The quantity of sewage discharged at Shelburne is so small that it has little effect on the river, but that discharged at Greenfield has a decided effect upon the river in periods of dry-weather flow. The sewer outlet is located quite near the mouth of the stream, however, and a serious nuisance has not yet resulted from the discharge of sewage at this outlet.

French River.

The French River below Webster is one of the most seriously polluted streams of the State, and investigations are under way for the removal of the sewage from the river and its disposal at some suitable place. The work has been seriously delayed and little progress has been made during the past year.

Hoosick River.

The Hoosick River receives considerable pollution at Adams, which has been increasingly noticeable as compared with previous years. Below North Adams the river is grossly polluted throughout the remainder of its course in the State, a condition which is due chiefly to the discharge of the sewage of Adams, North Adams and Williamstown into the river.

Housatonic River.

The extension of the sewage filter beds of the city of Pittsfield has removed much serious pollution from this river during the past year. Below Pittsfield the river has shown considerable improvement in 1916 and 1917 as compared with previous years. The treatment of certain manufacturing wastes in the city of Pittsfield is likely to become necessary if one of the principal tributaries in that city is to be maintained in satisfactory condition.

Merrimack River.

The improvement noted last year in the condition of the Merrimack River has been well maintained during 1917 throughout that part of the river from the point where it enters the State down to the city of Lawrence. The river between Lowell and Lawrence has shown less organic pollution than for many years. Below Lawrence, however, there has been a marked increase in the quantity of organic matter present in the water as compared with the previous year, and this increase is maintained, though in diminishing ratio as compared with 1916, throughout the remainder of the course of the stream.

Works have been constructed at Lawrence for the treatment of wool-scouring wastes from certain of the mills, and a portion of these wastes has been treated during the past year. The pollution of the stream has doubtless been more noticeable in 1917 on account of the reduction in flow due to a deficiency in the rainfall.

Millers River.

Millers River receives considerable pollution from Winchendon and Gardner on its upper waters, and is polluted farther down stream by the sewage of the towns of Athol and Orange, which is discharged untreated into the river. The condition of the main river has not been objectionable, however, and has shown less evidence of pollution during 1917 than for several years.

Nashua River.

The chief pollution of the Nashua River at the present time is the sewage of the city of Leominster, which is discharged into the north branch of the Nashua River a short distance below Fitchburg. The river also receives considerable pollution from Fitchburg, though most of the sewage of that city is removed to treatment works.

The south branch of the river receives considerable pollution from Clinton, and one of the tributaries of the main river is polluted by sewage from Ayer.

The analyses of the water show that the condition of the north branch above Leominster has been better than in several years, but that farther down stream at Lancaster the pollution is greater than in the previous year.

Considerable increase in the pollution is also noted in the water of the main stream at Still River above Ayer, where the quantity of organic matter is greater than was the case in 1916.

Farther down stream, also, increasing pollution is evident to the point where the river enters the State of New Hampshire.

Neponset River.

The condition of the water of the Neponset River shows on the whole little change as compared with 1916. Excepting at one establishment, practically nothing has been done during the year toward the construction of additional works for the treatment of wastes from the various mills which pollute this river, and late in the year difficulty was being experienced at some of the mills in obtaining chemicals suitable to maintain the methods of treatment already installed. In consequence, there is danger of a serious increase in the pollution of this stream during the coming year.

Quinebaug River.

There has been little change in the pollution of the Quinebaug River below Southbridge, which receives the drainage from the town and the filter beds. Steps are being taken by the town to improve the condition of its sewage-disposal works, and if these improvements are carried out promptly during the coming year, further objectionable conditions in this stream can be prevented.

Taunton River.

The Salisbury Plain River below Brockton has shown more evidence of pollution in 1917 than for many years, a condition which has been caused largely by the overflow of sewage from the Brockton sewerage system. The overflow of sewage has been due to a deficiency in the pumping capacity at the Brockton sewage pumping station, and, unless this is soon remedied, a very serious nuisance is likely to be created in this river.

The Town River below Bridgewater is seriously polluted by the sewage of that town, but the conditions in 1917 have shown no material change as compared with the previous year.

The pollution of the Taunton River above Taunton shows considerable increase as compared with previous years, but below the city the condition of the river remains about the same as in 1916.

The condition of the tributaries — the Nemasket River, Mill River and Three Mile River — has shown little change in 1917 as compared with previous years.

Ten Mile River.

The Ten Mile River shows a decided improvement since the introduction of sewage-disposal systems by the city of Attleboro and the town of North Attleborough and the extension of sewerage facilities in those municipalities.

Westfield River.

The most serious pollution of the Westfield River is that which is caused by the sewage of Westfield discharged into the river below the town. The condition of the river in 1917 has shown little change as compared with previous years.

Improvement of the Neponset River.

The work of the improvement of the Neponset River in the past year has consisted chiefly in a survey of the meadows to determine the ownership of the lands benefited by the improvement thus far made and of observations to determine what regulation may be necessary in the height of the flashboards on the dam at the Mattapan Mills. This work has been seriously delayed and the cost greatly increased chiefly by the frequent changes in the engineering force employed on the work. Certain recommendations of the Department relative to this improvement have been made in a special report to the Legislature on this subject and need not be repeated here.

WORK REQUIRED BY SPECIAL LEGISLATION.

Under legislation in 1917 a large amount of work was committed to this Department in making investigations under the following special acts of the Legislature: —

Hale's Brook in Lowell (chapter 92, Resolves of 1917).

Ipswich River (chapter 73, Resolves of 1917).

Lower Neponset River (chapter 52, Resolves of 1917).

The reclamation of wet lands, jointly with the Board of Agriculture (chapter 212, General Acts of 1917).

Investigation of Mystic Lakes and their tributaries, jointly with the Metropolitan Park Commission (chapter 45, Resolves of 1917).

Investigation of the pollution of Boston Harbor, jointly with the Metropolitan Water and Sewerage Board and the Public Works Department of the city of Boston (chapter 56, Resolves of 1917).

A considerable amount of work has been done by the engineering division of this Department in connection with the foregoing matters, all of which are the subjects of special reports to the Legislature and require no extended consideration here. It has been impracticable to obtain the necessary engineering force to carry out some of the work committed to the Department by the above legislation.

An extension of time has been requested to carry out the investigation of Hale's Brook in Lowell and as to the further use of the Ipswich River for water supply purposes. In the former case the appropriation appears to be adequate for the purpose of the investigation, but in the latter case a much larger appropriation will be required to carry out the work than was provided by the Legislature of 1917.

Advice to Cities, Towns and Others relative to Water Supply, Drainage and Sewerage.

In the following pages is given the substance of the action of the Department upon the more important matters presented to it during the year under the laws relating to the protection of inland waters, including advice to cities, towns and persons relative to water supply, drainage, sewerage and matters pertaining thereto.

WATER SUPPLY.

Auburn.

Under date of Aug. 22, 1917, the following communication was sent to the Board of Health of Auburn relative to the condition of the drinking water at certain houses in the northeasterly part of the town: —

The attention of this Department has been called to sickness in certain dwelling houses on Southold Road in the northeasterly part of Auburn near the boundary between Auburn and Worcester, and the Department has made an investigation to determine the source of the trouble.

It appears that the occupants of several dwelling houses along this highway have been using as their source of drinking water a brook which flows southerly from the northeasterly corner of Auburn near the boundary of the city of Worcester in the neighborhood of these houses.

An examination of the water of this brook shows that it is grossly polluted, and an examination of the watershed shows several highly objectionable sources of pollution along the stream. Most of these sources of pollution appear to be within the limits of Auburn, but one appears to be within the limits of the city of Worcester. In any case, this stream is not a safe source from which to take water for drinking and its further use for that purpose should be prevented. These dwellings should be provided with a water supply that is safe for drinking at the earliest possible time.

Belchertown (State School).

In response to a request from the Commission on Mental Diseases for advice relative to the water supply of the Belchertown State School, after tests made by means of tubular wells in various parts of the grounds, the Department replied as follows on July 18, 1917: —

The tests made consisted of sinking tubular wells in the neighborhood of the brook in the southerly part of the grounds, where the conditions appeared to be more favorable for obtaining water from the ground than elsewhere in this neighborhood. The tests were extended also down the valley of the main brook draining the institution grounds to a point 750 feet north of the highway which forms their northwesterly boundary. The results of the test show that, while porous soil was found at one or two places in the valley of the brook within the institution grounds, the water obtained was of poor quality, and ledge was encountered at no great distance below the surface.

The results of these tests show very clearly that it would be impracticable to obtain a ground water supply from the valley of the brook within the institution grounds. Tests made in the valley of the brook northwest of the institution grounds were also found to be unfavorable, the soil consisting largely of fine material which yielded little or no water.

In view of these results a general examination has been made of the ground in the valley of Bachelor Brook and its tributaries northwest of the institution, and especially in the neighborhood of the Upper, Middle and Lower ponds. The conditions for obtaining ground water near the Lower Pond appear to be unsatisfactory, judging from surface indications, and the character of the pond itself is such that a surface water supply from that source would be unsatisfactory in many respects. There is little doubt that a ground water supply could be obtained in the region of the Middle or Upper ponds, and good water could probably be obtained from the ponds themselves, but the distance of Lower Pond from the Stacy Farm is more than two miles, and the Middle and Upper ponds three miles or more.

An examination has also been made of the territory to the southeast and southwest of the institution grounds, and in the former region some small springs are found which will doubtless furnish water of good quality. They are located so near the head of the watershed, however, that it is unlikely that an adequate supply of water for all the requirements of the institution could be obtained from this region.

An examination of the ground in the valley of Jabish Brook east of the institution grounds shows that very favorable conditions for obtaining ground water are found at a number of places in the neighborhood of this brook within a distance of from one to two miles from the proposed location of the buildings on the institution grounds. Tests have been made in this region for the purpose of obtaining a water supply for the town of Belchertown, but there is no doubt that, even should a supply for that town be taken from the ground in this

valley, an ample quantity of water will also be available for the requirements of the institution as well.

In view of the circumstances, the Department recommends that you cause an investigation to be made with reference to obtaining a water supply from the valley of Jabish Brook at some point or points within reasonable distance of the institution grounds.

Under date of Oct. 3, 1917, the following communication was sent to the Commission on Mental Diseases in response to their request for advice with reference to taking a water supply for the Belchertown State School from the ground on the westerly side of Jabish Brook: —

The Department has caused the locality to be examined by one of its engineers and has considered the results of a pumping test made by pumping for a period of five days — from September 11 to 16 inclusive — from a group of wells in this locality. The wells used in the pumping test are located in a small island surrounded by land which was formerly under very active cultivation and were driven into a porous stratum, from which water could be drawn very freely. The quantity of water pumped from the wells continuously during the period of pumping amounted on an average to about 225,000 gallons per day, and observations of the height of the ground water in other wells in the neighborhood not connected with the pump showed that the level of the ground water was not lowered seriously during the test, the results indicating that an ample supply of water for all of the requirements of the proposed institution can be obtained from the ground in this locality.

Analyses of samples of water collected from the wells daily during the pumping test show that it is in all respects of good quality for the purposes of a public water supply. The region about the wells is sparsely populated and the purity of the water can be adequately protected by securing control of a moderate area of land about the wells.

In the opinion of the Department, the source is an appropriate and satisfactory one from which to take a water supply for the Belchertown State School.

Billerica (Talbot Mills).

Under date of Dec. 20, 1917, the Department replied as follows to a request from the Talbot Mills for advice as to the use of brass pipe in connection with the drinking water system of their tenements at North Billerica: —

The results of the examination show that the amount of copper in a sample of water collected on September 21, 1917, at the house of Joseph F. Talbot after standing over night in a brass pipe was .0486 of a part in 100,000, or .0283 of a grain per gallon. Examinations of brass pipe in other towns indicate that the quantity taken up by the Billerica water is probably somewhat greater than with other similar ground water supplies. In quantities such as have been found

thus far in the Billerica water, there is no indication that there is any danger to health in the use of this water after passing through brass pipe. It is possible, however, that a change in the character of the water or its condition at another season of the year might be such as to cause it to take up a greater quantity of copper than was the case at the time these examinations were made, and consequently before brass pipe is used extensively it is advisable that tests be continued at some of the places where it has thus far been introduced to determine what changes take place from time to time during at least a year.

It may be added that it is not likely that the Billerica water would affect injuriously a properly-made tin-lined lead pipe, and it is not likely that water drawn through such a pipe would be injurious to health. Pipes of wrought iron lined with cement are used extensively as service pipes in cities and towns. Such pipes might be extended to the kitchen in dwelling houses and danger of injury to the quality of the water by passage through the service pipe avoided in that way, since the water for drinking and cooking could all be drawn in the kitchen, and in that case brass or lead pipes could be used for all parts of the house.

Brockton.

In response to an application from the Board of Water Commissioners of Brockton for advice relative to filtering the water of Salisbury Brook Reservoir, and for the approval of the taking of lands bordering Silver Lake, the Department, under date of Jan. 31, 1917, replied as follows: —

From the reports of your engineer and chemist, it appears that the plan of filtering the water of Salisbury Brook Reservoir is designed to provide a supply of filtered water in times of emergency when, either through a break in the Silver Lake pipe line or a shortage of water during very hot, dry periods in the summer season, the works for supplying water from Silver Lake may be temporarily cut off or may be inadequate to supply all of the water required by the city.

The plan further contemplates the continued use of the filtered water of Salisbury Brook Reservoir for the supply of the city after the capacity of the present Silver Lake pipe line has been reached in order to postpone the necessary construction of a new pipe line to Silver Lake, which will inevitably be required eventually, until the consumption of water by the city becomes equal to the combined capacity of the present Silver Lake pipe line and the yield of the Salisbury Brook Reservoir.

From the reports presented and from the information contained in the published reports and records of the Brockton water department, it appears that the consumption of water in Brockton and in the towns and districts supplied with water from the Brockton works aggregated 2,839,000 gallons per day in the year 1915. The industries of the city of Brockton are not such as to require large quantities of water from the public works, and a large part of the service pipes of the city were metered many years ago and practically all services have been metered for the past eight years. Under these conditions the use of water

per person in the city of Brockton and in the towns and districts to which water is supplied from the Brockton works has not been large, and the increase in the use of water per person from year to year has been very small. If the yearly rate of increase in the consumption of water per person in the future should be twice as great as in the past twenty years and the increase in population no greater than is estimated in the report presented by your engineer, the consumption of water in Brockton would hardly reach 10,000,000 gallons per day in the next fifty years.

The present water supply of Brockton is pumped from Silver Lake through a force main 24 inches in diameter and a little less than 12 miles in length, and in connection with these works two concrete storage reservoirs are in use having an aggregate capacity of 8,000,000 gallons. The force main has a carrying capacity at the present time of 6,000,000 gallons in 24 hours, as estimated by your engineer, assuming that the friction head is not allowed to rise above 102 feet. These works with adequate pumping capacity at Silver Lake seem reasonably adequate for all present needs of the city, but as a precaution the old works for supplying water from Salisbury Brook Reservoir are maintained ready for use in any emergency.

It appears from the information submitted to this Department that the emergencies deemed most likely to arise which might require the use of water from the Salisbury Brook Reservoir at the present time are (1) a break in the pipe line from Silver Lake and (2) the exhaustion of the distributing reservoirs during prolonged periods of very hot and dry weather in summer.

No serious break in the main pipe line from Silver Lake appears to have occurred thus far since the works were built.

An examination of the pumping records during the past five years shows that the maximum quantity of water pumped has not thus far exceeded 6,000,000 gallons on any day in that period. It has exceeded 5,500,000 gallons on 8 days in the five years 1911–1915, viz., 1 day in 1912, 3 days in 1913, and 4 days in 1914; it has exceeded 5,000,000 gallons on 13 days in those years, viz., 2 days in 1912, 3 days in 1913, and 8 days in 1914. In the years 1911 and 1915 the quantity of water pumped did not equal 5,000,000 gallons on any day. Furthermore, it appears from the information supplied by your department that since the completion of the distributing reservoirs it has not been necessary to use water from the Salisbury Brook Reservoir to supplement the supply from Silver Lake at any time.

Should a break occur in the pipe line from Silver Lake which could not be repaired within a day or two, or should the quantity of water used in dry periods become much greater in proportion to the average consumption of water than has been the case in past years, a shortage might occur which would require the use of water from the Salisbury Brook Reservoir for a short time. The danger that such necessity may arise is remote, but if it should occur the use of water temporarily from Salisbury Brook Reservoir would cause only a temporary inconvenience and would not cause injury to health or to any other interest of the city.

A study of the rainfall in the region about Silver Lake indicates that the annual precipitation in that region is undoubtedly greater than on the Sudbury

River, and a study of the yield of watersheds in this region, including Silver Lake itself, shows clearly that the yield of these sources is greater in proportion to the rainfall than the yield of the Sudbury River.

From the best available data as to the probable yield of the watersheds in this region in a very dry period, including the yield of Silver Lake itself, the conclusion seems reasonable that Silver Lake will yield about 5,200,000 gallons per day without drawing its surface more than about 8 feet below high water. If the yield should be supplemented by the diversion into the lake of the waters of Howard and Pine brooks, the yield of the lake would probably be increased to about 10,000,000 gallons per day. The former quantity — 5,200,000 gallons per day — would be sufficient to last the city, on the basis of the estimates of your engineer, until after 1928, and if supplemented by Howard and Pine brooks, its yield would be adequate until after 1950. Unless, however, the increase in the use of water in Brockton is much greater in the future than in past years, the yield of Silver Lake as at present developed will be adequate for the supply of the city and the towns dependent on the city for water for at least 20 years, and if supplemented with the flow of Howard and Pine brooks, the yield of the lake would in all probability be adequate for the requirements of the city for the next 50 years, so far as can now be foreseen.

The cost of supplementing the supply from Silver Lake by the diversion into the lake of the waters of Howard and Pine brooks, as estimated at the time Silver Lake was first taken for the supply of Brockton, was $40,000. It is likely that the cost would be greater at the present time, but in all probability the cost will be much less than the cost of filtering the water of Salisbury Brook Reservoir, while the increase in the water supply of the city obtainable by the diversion of the waters of Howard and Pine brooks into Silver Lake would probably be as much as three times as great as the increase to be obtained by filtering and using the water of Salisbury Brook Reservoir.

A new pipe line to Silver Lake will be needed within a few years in any case, whether water is taken from the Salisbury Brook Reservoir or not. Furthermore, if the Salisbury Brook Reservoir is to be further developed and maintained for water supply purposes, it is probable that a considerable expenditure will have to be undertaken to protect that source of supply in the future. The watershed is three-fourths the size of that of Silver Lake, and on account of the limited capacity of the reservoir as compared with the area of the watershed, the expense of the protection of the quality of the water is likely to be much higher in proportion to the quantity obtained than is the case at Silver Lake.

Considering all of the circumstances, the excellent quality of the water obtainable from Silver Lake and the fact that an ample supply can be obtained there which, with an inexpensive development, will last the city probably for the next fifty years, it is most desirable, in the opinion of the Department, for the city to secure without delay all of the lands within the watershed of Silver Lake which seem likely to be used for settlement within the near future or which border the lake and can be acquired now probably for less expense than at a later time.

The Department approves the taking of lands shown on your plan entitled "Plan Showing Proposed Land Taking for the Protection of the Silver Lake

Water Supply City of Brockton." This taking includes three parcels: — one having an area of about 1.60 acres and extending westerly from Tubbs Meadow Brook to Edge Hill Road; a second having an area of about 0.84 of an acre and located on the easterly side of Tubbs Meadow Brook and bordering Silver Lake; and a third having an area of about 0.26 of an acre, being adjacent to and east of the second parcel.

It is important also, in the opinion of the Department, that the city should acquire much larger areas in the vicinity of the upper or northerly end of Silver Lake, especially the land bordering the lake and extending southerly from Edge Hill Road to land now owned by the city of Brockton. It is furthermore important that the city shall secure all of the low land adjacent to Tubbs Meadow Brook and the portion of the high lands bordering thereon extending from the lake back to and beyond Edge Hill Road. On the westerly shore of the lake the city now owns quite a considerable area, but there are other areas north and south of the pumping station which it would be advisable to acquire at the earliest opportunity. At the southerly end of the lake there are several cottages close to its shores and a considerable population in the neighborhood. It is desirable that control be secured of the lands bordering the lake in this region to prevent growth of population near the shores of the lake, and the acquirement of these lands should not be long postponed.

On the easterly shore of the lake opposite the pumping station the land appears to be held at present in large estates which are owned or occupied by persons who do not use the land in such a way as to affect the purity of the water. So long as these conditions continue it will probably not be necessary for the city to acquire extensive areas of land in this region, but the conditions may change at any time and the lands bordering the lake in this region and for a considerable distance back therefrom should be acquired from time to time as opportunity occurs. The expense of acquiring these lands will be considerable, but the importance of protecting this source of supply can hardly be overestimated.

Considering all of the circumstances, it does not appear to the Department advisable for the city to expend any more money than is absolutely necessary for the maintenance of the supply from Salisbury Brook Reservoir since this water can be used with safety at the present time and can doubtless be maintained in suitable condition for use in emergencies without special difficulty or expense until such time as a new main has been constructed from Silver Lake.

The Department strongly recommends the adoption of your plan for taking lands about Silver Lake and recommends that these takings be extended as herein indicated as rapidly as practicable. If the increase in water consumption in the city should become greater than now seems probable, it will be possible to purify the water of Salisbury Brook Reservoir as proposed by your engineer and thus provide a larger supply of water. It does not seem to the Department necessary, however, that purification works should be constructed at the present time for the treatment of the water of Salisbury Brook Reservoir, since a new pipe line from Silver Lake will soon be required in any case, and it is advisable that this work be begun as soon as the conditions become favorable for the purpose.

Dalton.

Under date of June 19, 1917, the Department replied as follows to the Board of Water Commissioners of the Dalton Fire District in response to their request for advice relative to the protection of that part of the water supply of Dalton taken from May Brook from the pollution that might be caused by the construction of a State highway within the watershed of the brook: —

The Department has caused the locality to be examined by its engineer and has considered the plans and information submitted. It appears from the original plans that the proposed highway would border a ditch in the location of the old abandoned highway in this region for a distance of several hundred feet, and the conditions were such that the drainage from the road would be very quickly washed into the ditch and thence into the west branch of the brook. A new plan of the highway has been presented, however, by which its location is moved somewhat farther to the north, and under this plan all drainage from the road can be disposed of in such a way as not to be discharged directly into the brook.

With this change the Department sees no objection to the construction of the road as shown on the modified plans, provided certain precautions are taken during and after the construction of the road. Just before construction is begun, the gate on the pipe leading from May Brook should be closed and kept closed during the entire period of construction within the watershed of the brook and for a period of several weeks after construction is completed and all equipment removed. During the construction of the highway no camp for the accommodation of laborers should be permitted within the watershed of May Brook, and provision should be made for removing all sewage from the watershed. The roadway should be fenced on both sides for a distance of 200 feet on each side of the easterly branch of the brook, while at the westerly branch the fencing should extend 200 feet in either direction from the brook on the northerly side of the highway and 400 feet on either side of the brook on the southerly side of the highway where it crosses the westerly branch, thus making the total length of fencing about 2,000 feet.

The Department further recommends that notices be posted warning the public that the streams are used as sources of public water supply and prohibiting the deposit of pollution within the watershed. Under the authority of the sanitary laws for the protection of water supplies a heavy fine is provided for such pollution, and the notices should so state.

After the completion of the road and in the course of its maintenance, the surface will doubtless be oiled, and at such times the use of the water should be discontinued for such a time as there might be danger that the quality of the water might be unfavorably affected thereby. It is also necessary that the men engaged in the maintenance of the highway be acquainted with the fact that the adjacent lands are gathering grounds of a source of water supply and that no pollution should be deposited thereon.

Fall River.

The following reply was sent to the Watuppa Water Board of Fall River on March 19, 1917, in response to their application relative to additional water supply, after a consideration of the report and plans presented: —

The information furnished by the report indicates that by the plan presented the capacity of the present water supply of Fall River can be increased by about 2,900,000 gallons per day at a cost of probably in the neighborhood of $600,000. While the growth of the city of Fall River has been somewhat less rapid in the past few years than formerly, there appears to be no reason to doubt that it will grow in the future at much the same rate as other similar cities have grown, both here and abroad, and in that case it is hardly likely that the proposed additional supply will last many years, probably not for more than ten to fifteen years, when a further addition will become necessary. A further additional supply, as discussed in the engineer's report, would require a further outlay, excluding damages, of $1,250,000 or more for works which, with the present works and the proposed Mill Brook addition, are unlikely to supply the city for more than twenty to twenty-five years. At the end of that time there would still be a large sum remaining to be paid on the bonds issued for the development of the three sources considered, and a further very large outlay would then have to be made for further additional water supply. Under these conditions, the Department believes that the legislation under which Fall River is now acting is not broad enough to give the city powers to make an adequate investigation to determine with reasonable satisfaction the best and most appropriate method of increasing its water supply. The Department further believes that it is possible that the Lakeville ponds may, ultimately if not in the beginning, be the best and most desirable source of additional water supply for Fall River, though subject to the prior rights of Taunton and New Bedford. There are possibly other sources which would be more desirable than those to which Fall River is now restricted by existing legislation.

Under the circumstances, the Department recommends that the development of your plans be postponed until a more extended investigation, which seems very necessary in this case, can be made and the most desirable source of additional water supply determined.

On July 19, 1917, the Reservoir Commission of Fall River submitted a report and plans of an additional water supply for the advice and approval of this Department, and under date of Sept. 4, 1917, the Department replied as follows: —

The investigations relative to increasing the water supply of the city of Fall River have included a very thorough study of the sources which appear to be most available in the immediate neighborhood of the present supply, viz.,

Bread and Cheese Brook, the Copecut River and Mill Brook. The results of these careful studies show conclusively that Mill Brook is likely to be the most economical and otherwise desirable of these available sources.

You have now, at the request of the Department, supplemented these studies with an investigation of the practicability and probable cost of securing an additional water supply from Long Pond, a source capable of yielding a far greater quantity of water than all of the three possible sources of additional supply previously investigated taken together, and you have also supplied the Department with all available information relative to your present sources of water supply and plans for its further improvement and control. The Department has caused the locality to be examined by its engineer and has considered carefully the information presented.

The quantity of water consumed in the city of Fall River in the year 1916 was 6,068,000 gallons per day. In the year 1910 it was 5,200,000 gallons per day and in the year 1905, 4,407,000 gallons per day. Your engineer estimates that the quantity required for the supply of the city in 1920 will be 6,700,000 gallons per day, in 1925, 7,500,000 gallons per day, and in 1930, 8,200,000 gallons per day. A study of the records of flow of North Watuppa Pond in recent years, and especially of the very careful measurements made by your board in the years 1899, 1900 and 1901, shows conclusively that the yield of this watershed exceeds materially the yield of equal land surface areas in the watershed of the Sudbury River, commonly used as the basis of estimating the yield of watersheds in this region. This greater yield is due largely no doubt to the difference in the distribution of the rainfall in southeastern Massachusetts as compared with its distribution in more central areas. Calculations based on the thorough measurements made in previous years show that the capacity of North Watuppa Pond with its present watershed is sufficient to provide an adequate quantity of water for the city for at least ten years in the future upon the basis of the estimates given above, by drawing the water to a somewhat lower level than it has been drawn in previous years, but not probably lower than about nine feet below the present high-water level. This extra draft would require extra pumping and changes in the intake at the pumping station, but otherwise would have no objectionable effect, assuming that the flowage rights on the North Watuppa Pond are to be acquired by the city as proposed. The drawing down of the water to a level 9 feet below the present high-water mark would expose a considerable area of shore but is unlikely to produce any more objectionable results than would be produced by drawing the water to the lesser depth, which will be necessary with smaller yields. It will be unnecessary, however, in any case, to draw the pond down more than 5 or 6 feet within the next five years, even if no additional supply is provided, of course assuming that the city acquires the flowage rights of the North Pond as proposed.

In the report now submitted you have presented an estimate of the cost of obtaining a supply from Long Pond equal to that obtainable from Mill Brook, and the result shows that, leaving out the cost of water damages in the case of Mill Brook and the cost of land and water damages in the case of Long Pond, the cost of a supply from Mill Brook as estimated would be $375,000 and from

Long Pond $530,000. A careful consideration of the probable cost of water damages under the two schemes indicates that the cost in the case of Long Pond is likely to be very considerably less than in the case of Mill Brook. The cost of land damages, if a supply should be taken from Long Pond, is unlikely to add very materially to the cost of the works so far as the amount of land required for pumping station and pipe lines is concerned.

Considering the circumstances, the difference in the cost between these two schemes is unlikely to be a very considerable one. On the other hand, a comparison of the advantages of the two plans appears to show that Long Pond is likely to be a more economical and desirable source for supplying Fall River than Mill Brook, the Copecut River and Bread and Cheese Brook, the sources most available in the immediate neighborhood of the present supply. The water of Long Pond is likely to be of much better quality than that which will be obtained from Mill Brook and the other sources in its neighborhood, if reservoirs are constructed on these streams of the size and character proposed. The quantity of water which Long Pond is capable of furnishing is much greater than the aggregate quantity that can be furnished by the other three sources taken together, and, finally, the city of Fall River must eventually go to Long Pond or some other portion of the Middleborough pond system for its future water supply, or else to some other large source probably at a greater distance.

The Department has considered carefully the possibility that, unless the sources in the immediate neighborhood of Fall River are acquired at once, they may be developed for other purposes and cease to be available for the use of the city, unless at greater cost, but it is also probable that the cost of obtaining water from Long Pond also will increase in the future, unless the right to the use of that source is secured at no distant time.

In view of the probable growth of the city of Fall River and the probable increases in the uses of water in the future as compared with the present time, the Department believes that it will be for the best interests of the city to secure the right to take water from Long Pond, or some other part of the Middleborough pond system, using its funds from the beginning for the development of that source, if it is practicable to secure the right to take water therefrom, rather than to expend the greater sum that will be needed for the development of the smaller supplies, with the probability — which amounts practically to a certainty — that the city must build works to take water from Long Pond in the not very distant future.

The Department believes that the city of Fall River is fortunate in having no immediate need of any additional supply, particularly at a time when labor and materials are unusually scarce and expensive.

The Department accordingly recommends that the city of Fall River petition the Legislature of 1918 for authority to take water from Long Pond and to convey the same, or so much thereof as may be necessary for the supply of the city, to North Watuppa Pond and that it have such other powers as may be necessary to develop a proper water supply from that source; and until this question is determined, the Department advises that no further action toward securing water from Mill Brook be taken.

On Oct. 19, 1917, the Reservoir Commission again applied to the Department for advice relative to additional water supply, and after further investigations the Department, under date of Nov. 24, 1917, replied as follows: —

The results of these investigations indicate that the conclusions reached in the reply of this Department of September 4, 1917, are fully justified, upon the basis of the plans, reports and estimates presented, and upon the assumptions as to the control of North Watuppa Pond and the future use of water therefrom therein clearly stated.

In view of these results and of the fact that the city of Fall River has not yet secured control of North Watuppa Pond, the Department in the present circumstances disapproves the plans presented by you for the taking of water from Mill Brook as an additional water supply, under the provisions of Chapter 302 of the Special Acts of the year 1916.

The report of the Committee of the Public Health Council on Sanitary Engineering upon this subject is appended.

The report of the Committee on Sanitary Engineering to the Commissioner of Health and the Public Health Council, mentioned in the foregoing communication, is as follows: —

Your Committee on Sanitary Engineering has considered the further communication of the Reservoir Commission of the city of Fall River, dated October 19, 1917, relative to additional water supply, and, in view of the statements therein contained, has re-examined the whole question and now presents the following report:

The most important allegation in this communication is that which concerns the statements of this Department in its communication of September 4, 1917, relating to the yield of North Watuppa Pond and its capacity for supplying an adequate quantity of water for the present and future needs of the city of Fall River. This allegation is as follows:

. . . It is clear that your statement in regard to the capacity of North Watuppa Pond for the city's water supply is based upon incomplete information and is therefore entirely misleading and erroneous. Furthermore, your statement contradicts your previous opinion on this matter as given in your report to the Watuppa Ponds and Quequechan River Commission dated Sept. 2, 1915 (see p. 33 of the printed report), where the following statement appears: —

"The consumption of water in the city is increasing steadily, and in the past few years quite rapidly, and with the recent reduction in its drainage area the quantity of water drawn from the North Pond will soon equal the yield of that source in a series of very dry years."

In its communication of September 4, 1917, the Department expressed the opinion that —

. . . the capacity of North Watuppa Pond with its present watershed is sufficient to provide an adequate quantity of water for the city for at least ten years in the future upon

the basis of the estimates given above by drawing the water to a somewhat lower level than it has been drawn in previous years, but not probably lower than about nine feet below the present high-water level.

The capacity of North Watuppa Pond for supplying the city of Fall River, assuming full control of the pond by the city, is dependent mainly upon three factors, viz., (1) the yield of the watershed; (2) the amount of storage utilized, i.e., the depth below high water to which the water may be drawn; and (3) the quantity of water that will be used for the supply of the city. The basis of the calculation of the yield of the pond, used by the Department, is the record of actual measurements of the flow and draft from this pond, which were accurately made for many years beginning in 1899 and continuing up to within the past few years, since which time the observations are believed by the engineer of the Fall River Reservoir Commission to be unreliable. The Committee finds that the calculations of the yield of North Watuppa Pond on the basis used by the Chief Engineer show fluctuations in the height of the pond which agree so closely with its actual fluctuations in level in the years when the records of its flow are acknowledged to have been accurately kept as to prove that the method used is both accurate and reliable.

In estimating the future yield of the pond and the probable fluctuations in its water level, it has been necessary to make an assumption of the probable quantity of water that will be required by the city, and in these calculations the Committee finds that the Chief Engineer of the Department used the estimate made by the engineer of the Fall River Reservoir Commission and presented in his report of November 17, 1916, page 4. It is true that the estimate of the future water consumption made by this Department in 1915 was greater than that recently made by the engineer of the Reservoir Commission, but since 1915 there has been a material change in the circumstances affecting the growth of population on account of the fact that the United States has declared war against Germany. Experience in the war of 1861–1865 showed that the rate of growth of population in Massachusetts cities was substantially retarded and that the population in some of the cities in fact actually decreased. In view of this situation, the Committee believes that the reduction in the estimated future population is justified.

On the basis of actual yield of the watershed of North Watuppa Pond and the assumptions as to future use of water, and the further assumption that the city of Fall River will secure and exercise in the near future exclusive control of the North pond, the computations of the Chief Engineer show that, with a rainfall like that of the dry period beginning in 1904, the maximum reduction in the height of water in North Watuppa Pond in the next ten years would be between 6 and 7 feet. This calculation takes account of the diversion of 0.58 of a square mile in the watersheds of Ralph and Nat brooks contemplated but not yet made. In order to provide for contingencies, such as a drier period than the one considered, the Department stated in its reply of September 4 that it was not likely that the pond, under the conditions assumed, would be drawn down lower than about 9 feet below its present high water level.

The Committee has examined these computations and finds that they are

based on the best available data, that they were accurately made, and that the conclusions based thereon are justified. The Committee has examined the diagram of the yield of North Watuppa Pond appended to the engineer's report submitted with the communication of the Reservoir Commission on which the conclusions of the Reservoir Commission relative to the yield of the pond appear to be based. Upon this diagram the estimated height of the pond from year to year is shown on the assumption of a constant use of water for the supply of the city of 7 and 8 million gallons per day respectively, but as both of these assumptions are in excess of his estimated use of water in Fall River for several years in the future, the calculations shown on this diagram are not applicable in the present circumstances. An error appears to have been introduced into these calculations, namely the neglect to take account of the marked variations in the relative areas of land and water surfaces due to fluctuations in the level of the North pond which would be caused by the assumed drafts. In consequence, these calculations show a much smaller yield of the watershed than is actually the case.

The Committee finds that the conclusion of the Reservoir Commission quoted above, viz., that —

> . . . It is clear that your statement in regard to the capacity of North Watuppa Pond for the city's water supply is based upon incomplete information and is therefore entirely misleading and erroneous.

is not justified by the facts.

The Reservoir Commission also states in its communication that —

> . . . A draft of 9 feet would expose over 600 acres of shores and flats, which would certainly result in unsatisfactory quality of water, as the shores would be exposed for many years at a time, resulting in thick growths of vegetation and the deposition of foreign matter which would either have to be removed or have a bad result on the quality of the water at times when the water level was temporarily raised.

and that —

> We find, going back only a few years, to the Annual Report of your Department for 1909 (pp. 10–11), attention specially called to the bad results and the serious trouble that has occurred on other natural ponds in the state on account of excessive draft and exposure of shore areas during a period of dry years.

There follows a quotation from the report of the State Board of Health for that year relating to the excessive drawing down of Crystal Lake in Gardner, Farm Pond in Sherborn, Suntaug Lake in Lynnfield, and Sandy Pond in Lincoln.

As to these quotations, the Committee finds that there is nothing in that report which refers to the effect of the draft upon the quality of the water in the ponds mentioned. The conditions complained of in those cases did not relate to the quality of the water. Ponds and reservoirs within the State have often been drawn down not only 9 feet but to much lower levels with shores exposed for years without affecting unfavorably the quality of their waters.

The Committee finds that the fluctuations which would occur in the surface level of North Watuppa Pond, based upon the calculations of yield and draft already stated, would be very similar to the fluctuations in level that have

occurred without bad effects in this pond in the past, as shown by the records published in the reports of the Watuppa Water Board for many years. It must be remembered that, even if drawn down 9 feet, such draft represents the lowest point to which the pond might be drawn; so that, if drawn to that depth, its level would remain there for a very limited period, probably at most for a few weeks only in the very late fall or winter, and that its level would quickly rise with the high run-off in the winter and spring precisely as it has done in the past. In fact, the exposure of the shores of the pond would be but little greater — and then only toward the end of the period of ten years for which the supply is likely to last — than the fluctuations which have occurred in this pond in other years, in connection with which there has been no evidence of injury to the quality of the water.

Regarding the intimation of the Reservoir Commission that changes would of necessity be required in the pumping station foundations and intakes to provide for such a draft as would be necessary if the North pond were drawn down 9 feet, the Committee is not convinced that any expensive changes would be needed. It is not infrequently necessary to raise water to an intake or pump well on account of the drawing down of a pond. Such conditions have been met commonly without much difficulty or cost.

The Reservoir Commission calls attention to another item of expense which, it states, this Department has overlooked, viz., the necessity of tightening the cut-off wall at the dam between the North and South ponds at the Narrows, in order to prevent the pollution of the North pond. The Commission states,

> . . . This dam was not constructed so as to permit any such extreme difference in level of the ponds as you propose. Consequently it would have to be tightened at a large cost, to prevent the relatively polluted water of the South Pond entering the water supply of the city.

If it be true that the present dam is in such a condition that water may leak from the South to the North pond, then it is also possible for water to leak from the North to the South pond, in which case the dam should be strengthened to prevent loss of water. The South pond before an additional supply is introduced into the North pond would presumably be drawn down to much the same extent and at much the same time as the North pond. Even should considerable difference occur, there is no serious danger that water from the South pond filtering through the embankment between the ponds would have a noticeable effect on the quality of the water of the North pond. It is probable that the waters of the South pond adjacent to the embankment would never be very badly polluted, and any pollution of that part of the South pond would doubtless be represented chiefly by floating matter. The passage of the water through the embankment would inevitably leave behind such floating matters, while the possibility of any disease germs ever passing through the embankment is, in the opinion of the Committee, negligible. Danger of pollution of North Watuppa Pond in the neighborhood of this embankment from fishermen now tolerated there is vastly greater than the possibility of pollution of water passing through the embankment from South Watuppa Pond.

Regarding the quality of the water of the proposed reservoir on Mill Brook

as compared with that of Long Pond, we find no reason for changing the opinion of the Department already expressed. Mill Brook Reservoir will flood a large area, considerable portions of which will be shallow, and the water could be drawn only from its shallow upper end. The reservoir is to be prepared for the storage of water, judging from the estimates of cost presented, only by clearing and a limited amount of grubbing. The water of such reservoirs is almost invariably affected for many years after construction by vegetable growths, high color, and disagreeable tastes and odors. Long Pond, on the other hand, is a natural pond, and there are no evidences of serious growths of organisms in its water, which already forms a large part of that now used by the city of Taunton. All things considered, the quality of the water of Long Pond is likely to be much better than that of the proposed reservoir on Mill Brook.

The comparative estimates of the cost of works for taking water respectively from Mill Brook and Long Pond presented by the Reservoir Commission seem to us inconclusive. In taking water from Long Pond it would not be necessary to pump 3 million gallons of water per day throughout the year; in fact, in some of the earlier years little or no water would have to be pumped from Long Pond if North Watuppa Pond is under the exclusive control of the city. The water could also be drawn during periods of the year when the flow was large, and in consequence of these circumstances, the damage to water rights would be small, at least for many years. After the first installation no material enlargement of the works would be required for a long period of years, since suitable works built for taking water from Long Pond in the beginning would provide a greater supply than 3 million gallons per day. Furthermore, the cost of a water supply from Long Pond would not involve the taking of all of the dwelling houses and cottages within the limits of its watershed, as implied in the communication of the Reservoir Commission. The watershed contains no city, town or considerable village, and the population at the present time is smaller than on watersheds which are being maintained in satisfactory condition for the purposes of a public water supply. The water of Long Pond would not be supplied directly to the city but would be delivered into North Watuppa Pond or its northerly feeder, thus entering the pond several miles from the intake.

Your Committee believes that the cost of a supply from Long Pond has been overestimated, especially as regards the probable cost of land and water damages, including the cost of the protection of the watershed. The development of the smaller sources would involve a very large expenditure, and even with full development it is certain that, in spite of the war, at no very distant time a further additional supply would be necessary if the city of Fall River should grow in the future as it and similar cities have grown in the past. It is therefore important for the city of Fall River to examine much more carefully the probable cost of obtaining an additional water supply from Long Pond for comparison with the cost of developing the smaller supplies, to which attention has been thus far chiefly directed. The Committee believes that the city will have ample time for making this investigation in view of the probability that no addition to its water supply would be needed for a considerable number of years in the future, provided the control of North Watuppa Pond is immediately secured.

In conclusion, the Committee feels that, until the question of the control of North Watuppa Pond by the city, or at least the extent of the control which the city feels able or deems desirable to assume, is determined, the question of an additional water supply should be held in abeyance, because the amount of additional water supply needed is largely dependent upon the extent of the control which the city assumes in North Watuppa Pond. If the city soon secures full control of that source, it will have an ample water supply for a considerable time in the future, and we see no reason to modify the opinion expressed in the communication of the Department of September 4, 1917, that North Watuppa Pond will supply sufficient water for all requirements for the next ten years, unless the increase in the consumption of water proves greater than is now reasonably estimated. In any event, ample warning of the need of an additional supply would be given by the gradual depletion of the storage in the pond from year to year, so that preparation for the introduction of an additional supply can be readily made in season to prevent danger of shortage.

We therefore recommend that the Department disapprove the plans for taking an additional water supply from Mill Brook under the provisions of Chapter 302 of the Special Acts of the year 1916.

Gardner.

The Board of Water Commissioners of Gardner petitioned the Department on June 23, 1917, for its consent and approval of the taking of certain lands on the southeasterly side of Crystal Lake for the purpose of protecting and preserving the purity of the water of said lake, the source of water supply of the town. After a hearing, held on July 19, 1917, the Department approved the taking.

Georgetown.

In response to a request from the Board of Selectmen of Georgetown for advice relative to a water supply for that town the Department, after an examination of test wells driven northwest of the village between Main Street and the railroad, replied on Jan. 16, 1917, as follows: —

The wells penetrated a deep stratum of coarse material from which water could be pumped freely with a hand pump. Analyses of water from two of these wells show that, while the water is clear, colorless and odorless, it is affected by an excessive hardness, probably due to drainage from dwelling houses along Main Street. It is possible that, if a pumping test were made, the quality of the water would show improvement, but, considering the circumstances, it is advisable, in the opinion of the Department, to locate the collecting works at a greater distance from dwelling houses.

It is probable that by going up the valley northwest of the present wells a

location could be found where the ground water would be unaffected by drainage from the populated parts of the village, and the Department recommends that tests be made by sinking wells in that region. If the conditions are found to be favorable for obtaining water of good quality, it is advisable that a test be made by pumping continuously from a group of wells in this locality for a period of at least a week to determine the probable quantity and quality of the water that can be obtained continuously from the ground in that region.

Gosnold (Cuttyhunk).

On May 17, 1917, an application was received from the Board of Selectmen of Gosnold for the approval of the Department of a proposed source of water supply for the village of Cuttyhunk, the source being a well on the premises of Walter H. Allen. On June 19, 1917, the Department replied as follows: —

It appears that the well was originally dug to a depth of 24 feet, lined with masonry and so constructed as to prevent danger of surface water entering the well. It appears that a 15-inch pipe has been sunk to a further depth of about 11 feet, and the information furnished the Department indicates that water stands in this pipe to a depth of about 7 feet in the drier part of the year. It is said that a considerable quantity of water, probably twice the amount required for the village, was drawn from the well for a time in the spring of 1912, but no adequate test has been made which would serve to indicate the quantity of water which the well is capable of supplying.

The results of an analysis of a sample of the water showed that at this time it was clear, colorless and odorless, contained but little organic matter and was free from objectionable bacteria. The water is quite hard, however, and shows evidence of previous pollution, though the water entering the well at this time was being thoroughly purified in its passage through the ground. The pollution of the well is probably caused by the sewage discharged upon or into the ground at dwelling houses in the village, which is located on a slope above the well, but since it is understood that you propose to install a sewerage system at the same time as the water works are introduced, it is probable that the sources of pollution of the well will be removed, provided all sewage is discharged into the sewers.

Considering the circumstances, the Department is of the opinion that the water of this well can probably be used with safety for the present, and it appears probable, judging from the information furnished as to the yield of the well, that the quantity will be adequate for the supply of the village, in the beginning at least.

The water may deteriorate with continued pumping and should be analyzed from time to time and the use of the well discontinued if the quality of the water deteriorates. In case of deterioration in the quality of the water, or in case the quantity should prove inadequate for all requirements after the supply has come into general use, it is important, in the opinion of the Department, that a new source of supply be developed at some suitable place in the neighborhood of the

village. In selecting a new source care should be taken to locate it at such a point that it will not be exposed to danger of pollution by drainage from dwelling houses, and the well should be constructed of sufficient capacity, if a suitable location is found, to provide an adequate quantity of water for all requirements. In seeking such a location the town should secure the advice of this Department before proceeding with the construction of works.

The Department has also considered the proposed plan of sewerage and sewage disposal and finds that the plan provides for taking the sewage from the central portion of the village and for discharging it into the sea on a rocky shore at a point southeast of the village. The location of the proposed outlet appears to be an unobjectionable one, under the circumstances, and the sizes and grades of the proposed sewers appear adequate for the purpose.

The Department approves the proposed plan of sewerage and recommends that it be extended to include all of the dwelling houses in the village.

Gosnold (Penikese Island).

In response to a request from the State Board of Charity for advice relative to a water supply for the hospital on Penikese Island the Department, under date of June 19, 1917, replied as follows: —

It appears that the area of the island is about 74 acres and that it has a present population, including patients, of about 25, though the buildings have accommodations for a larger number. The present water supply is obtained from three wells, each about 10 feet in diameter and from 12 to 14 feet in depth, located south of the administration buildings at a place where they do not appear to be exposed to danger of pollution by sewage. These wells are located but a few feet apart, and the water, as shown by the analysis of a sample from the southwesterly well in the group, is clear, colorless and odorless but contains a larger quantity of organic matter and a larger number of bacteria than are found in good well waters. The water is also quite hard and contains a considerable quantity of iron which is probably sufficient to make it objectionable for some uses.

A sample from another well in the immediate neighborhood of the three already described, which is used as a source of drinking water for the administration building, was found to be of much the same quality as that of the other wells, except that it is decidedly harder and contains a greater quantity of iron. There are also some indications that some of the water entering this well has been polluted, though well purified in its subsequent passage through the ground before entering the well.

The water of the three main wells is pumped to two covered reservoirs located at the highest point on the island and having a capacity of about 100,000 gallons. The quantity of water which these sources yield, however, is inadequate during the drier part of the year for the requirements of the hospital, and it is necessary to ship water to the island from outside. It appears that an attempt has been made to secure an additional supply of water by sinking a tubular well — 8

inches in diameter to a depth of 130 feet — in the bottom of one of the wells now used as a source of water supply, but the result of this test was unsatisfactory.

A general examination of the island indicates that the area from which it appears to be possible to obtain a supply of good water is quite limited, and the character of the soil appears to be rather unfavorable in all parts of the island for obtaining water from the ground in any considerable quantity. The most favorable part of the island in which to make tests with a view to obtaining an additional water supply appears to be in the northeasterly portion of the main part of the island at a point at least 500 feet from the northeasterly shore and at least 300 feet from the cove separating the two portions of the island. If ground water can be found at this point it is unlikely to be affected by objectionable drainage, and if the soil is porous enough to yield water in sufficient quantity, it is probable that water of suitable quality for use in the hospital could be obtained in this location.

The only practicable way of determining whether sufficient good water for the requirements of the hospital can be obtained in this region would be by making tests in the region indicated by sinking one or more wells to a depth of 12 to 15 feet and, if water is found, by testing the yield by pumping for a few days at a rate somewhat greater than would be required for the supply of the hospital. If a location is found at which considerable water can be obtained, the Department will test the quality of the water, and when the results of these tests are available will, upon request, give you further advice as to the probability of obtaining a suitable water supply for the buildings in this location.

Another request was received from the State Board of Charity for advice as to the condition of the water supply at Penikese Island, to which the Department replied as follows on Dec. 10, 1917: —

Regarding the present sources of supply, the Department finds that the conditions have not changed since its statement of June 19 last, except that the need of an adequate water supply has become more apparent. Since that time, your Board has caused a test well to be dug in the region recommended by this Department in its communication of June 19 last, this locality being about 500 feet from the northeasterly shore of the island and 300 feet from the cove which separates the two main portions of the island. This test well is 6 feet square, 12 feet 7 inches deep, and contains ordinarily about 7 feet 6 inches of water. The soil encountered in excavating the well was rather fine, though admitting water with considerable freedom. The test made by pumping from the well with a hand pump indicates that a quantity of water sufficient for all the requirements of the institution can probably be obtained from the ground in this region.

Owing to the character of the soil, which is quite fine, the present well is probably too small to furnish an adequate water supply in the drier portion of the year, and it is advisable to construct a well of much larger size or else to construct two or three wells in order to obtain the quantity of water required for the supply of the institution.

In order to determine the probable quality of the water of the test well, the Department has had samples of water collected at four different times since the well was completed. The water at the time of the first examinations was evidently affected by the work done on the well, but the later examinations show a decided improvement in quality and indicate that a water which will be safe for drinking and can be used for all purposes in the institution can be obtained from the ground in this region.

The Department recommends that a well at least 20 feet in diameter and about 5 feet in depth be constructed at the location of the present well, unless ledge is encountered nearer the surface, and that, if the yield from this well is found insufficient for the requirements of the institution at all times, the works be extended by the construction of an additional well in this neighborhood whenever the need for an additional supply becomes necessary. The supply of water to be obtained from the ground in this region is limited in any case, but it is likely that enough water for the requirements of the institution can be obtained by means of suitable wells as suggested. As the present water supply is insufficient and of inferior quality, the new wells should be constructed and made ready for use at the earliest practicable time. The works should be constructed under the direction of an engineer experienced in such work.

Hanson (Tuberculosis Hospital).

In response to a request from the County Commissioners of Plymouth County for advice as to the practicability of obtaining a water supply for the county tuberculosis hospital in South Hanson from a spring located about 750 feet northeast of the main group of buildings, the Department, under date of Oct. 29, 1917, replied as follows: —

Under the circumstances, it is probable that water of good quality for the use of the hospital can be obtained from the ground in this location so long as the surroundings remain as at present, but the practicability of obtaining a sufficient quantity should be determined by means of a test on tubular wells. If the water supply of the hospital is obtained in this locality, it is especially important that the sewage be conveyed to some point as remote as possible from the spring, at least 700 feet distant therefrom, and so located that this sewage will be unlikely to percolate through the ground toward the spring. It is also important that a considerable area of land in the neighborhood of the spring be controlled in order to prevent danger of its pollution.

Haverhill.

In response to a petition from city officials of Haverhill, requesting that skating be allowed on Lake Saltonstall, the Department, under date of Jan. 24, 1917, sent the following communication to the Board of Water Commissioners of Haverhill: —

The Department finds that it is unable to recommend that skating be permitted on the lake at the present time since the lake is a part of the water supply

of the city of Haverhill which may be used at any time in an emergency, but in the course of the recent examination of the lake, while the water was at this time found to be safe for drinking, certain conditions were found to exist which are, in its opinion, a menace to the purity of the water and should be removed if the use of this source is to be continued.

The westerly part of the watershed of the lake is densely populated, but the sewage of dwelling houses in this region is removed from the watershed by means of sewers and only a very few houses within this watershed now dispose of their sewage into cesspools. None of these cesspools appear at the present time to be a serious menace to the purity of the water, but the surface water flowing from a densely populated region west of the lake may cause pollution of the water, and it appears to the Department advisable that measures be taken to prevent danger of pollution from this cause if the use of the lake is to be continued.

The best practicable plan of effectually preventing the danger of pollution of the lake from the thickly populated areas in the westerly part of its watershed will probably be to construct a drain from the outlet of the lake along its southwesterly and westerly shores and along a portion of the northerly shore which will intercept all surface water from the most populous areas and convey it to the drain which forms the outlet of the lake through Mill Street. In connection with this improvement it would probably be necessary to enlarge the drain or sewer in Mill Street since there is doubt as to its capacity for removing the drainage from the areas indicated in times of heavy storm. In connection with the removal of the drainage from the westerly part of the watershed, it will be advisable for the city to control sufficient areas in the easterly part of the watershed to prevent pollution of the lake, if that part of the watershed is to continue tributary thereto, since these areas can probably be acquired at less expense at present than will be the case if further buildings are constructed thereon.

It is obvious that the cost of protecting the lake by this plan, or any reasonable plan, will be large, whereas, on the other hand, the yield of the lake represents but a comparatively small percentage of the total yield of the watersheds from which the portion of Haverhill north of the Merrimack River is now supplied. It will, therefore, be advisable to secure careful estimates of the cost of the work necessary to protect the purity of the water of the lake in order to determine whether the expense will be justifiable. While Lake Saltonstall has considerable value for storage purposes, even if its watershed should be partially diverted, the lake lies at a low level compared with the other sources, and the advantages of its use at the present time do not appear to be great. It is possible that these advantages could be offset by a suitable connection from the works on the south side of the river which would make it practicable to provide a considerable quantity of water from the sources on that side in case of need.

Considering the circumstances, the Department recommends that you cause an investigation to be made of the probable cost of protecting Lake Saltonstall in the manner suggested or by any other practicable plan, including the cost of enlarging the outlet drain through Mill Street to the Merrimack River, if such an enlargement is necessary, and the cost of providing suitable connections for

the use of considerable quantities of water from the south side of the river in case of need.

When the results of the investigations herein suggested are available, the Department, if you so request, will advise you as to the practicability and advisability of continuing the use of this lake as a source of water supply.

Hingham.

On Oct. 20, 1916, an application was received from the Hingham Water Company for advice relative to the taking of certain lands in Hingham for the protection of the sources of water supply of Hingham and Hull. These lands comprised one parcel in the watershed of Fulling Mill Pond and one parcel in the watershed of Accord Brook, and the Department, after investigation, found that the acquisition of these lands was necessary for the protection of the water supply of Hingham and Hull. The taking was approved on Jan. 20, 1917.

Subsequently a communication was received from the Hingham Water Company relative to the reconveyance to the former owner of a portion of the parcel of land in the watershed of Fulling Mill Pond, referred to above, and the Department, finding that the retention of this area was not essential for the protection of the water supply in Fulling Mill Pond, recommended its release on Aug. 31, 1917.

Lawrence.

On Dec. 28, 1917, the Department replied to an application from the Water Supply Committee of Lawrence containing certain questions relative to the Merrimack River and the Lawrence city filters. The questions and reply were as follows: —

1. Is it practicable to remove the sewage and manufacturing wastes of the cities and towns above Lawrence on the Merrimack River and its tributaries and if this were done to what extent would it relieve the burden on the Lawrence filters?
2. What would be the effect of such treatment on the cost and efficiency of filtration at Lawrence and on the character of the filtered water?
3. If such sewage and trade wastes are not treated or removed what in the opinion of your department will be the probable condition of the Merrimack River water in Lawrence thirty years hence?
4. What is the exact condition of Merrimack River water at the present time before filtration and what is its condition after filtration?

The Department has examined the records and other data relating to the river and its water at various points collected in the past thirty years and appends hereto summaries of the more important parts of this information.

In answer to the first question, the Department is of the opinion that it is undoubtedly practicable to remove from the river a part of the sewage and manufacturing wastes of the cities and towns situated upon the river and its tributaries above Lawrence. In fact, a considerable portion of the sewage and manufacturing wastes formerly discharged into some of the tributaries of the river has already been removed and is being treated at disposal works, the effluent from which is returned to the streams.

The cities and towns above Lawrence which discharge sewage into the river and its tributaries for the most part are widely scattered, and if the removal of the sewage were required at the present time it would probably be found least expensive for each city and town to treat its sewage separately in its own neighborhood. It would probably not be practicable to dispose of all of the sewage and manufacturing wastes at points outside the drainage area, nor is it likely to be practicable to combine several cities and towns in any part of the watershed and form a sewage disposal district.

No method of treatment or removal of the sewage from the Merrimack River above Lawrence that it is practicable to adopt will prevent the continued pollution of the river by sewage, manufacturing and other wastes to a greater or less extent. Most of the sewerage systems in the older and larger cities along the river are constructed upon the combined plan, receiving both sewage and storm water, and it would be impracticable to treat all of the sewage from such systems at times of storm. Furthermore, if the sewage were wholly separated from the storm water in all the cities and towns, the storm water alone would cause a very considerable pollution of the streams, especially the storm water derived from populous areas. In the factories and mills also great quantities of water are used in some of the processes which are not seriously polluted and which it would be unreasonable to attempt to treat or purify. For the foregoing reasons it is impracticable to prevent the pollution of the Merrimack River to a greater or less extent by sewage, manufacturing wastes and other drainage from the great population dwelling within this watershed.

The second portion of question 1 is, if the sewage and manufacturing wastes of the cities and towns above Lawrence were removed from the river, to what extent would such removal relieve the burden on the Lawrence city filters?

An investigation of the circumstances shows that it would not be practicable by any reasonable method of treating the sewage, drainage and manufacturing waste of the city of Lowell, or by any practicable plan of removing those wastes from the watershed, to prevent a very considerable pollution of the river as it passes the city of Lowell; in fact, it is not probable that the river above Lawrence could be improved to such an extent by the treatment proposed that it would be less polluted than the river now is above Lowell. If the removal of sewage from the river should make it practicable to bring the water above Lawrence to the condition of that of the river above Lowell, however, the difference would hardly be noticeable in the operation of the Lawrence city filters.

The second question is "What would be the effect of such treatment on the cost and efficiency of filtration at Lawrence and on the character of the filtered water?" — the treatment proposed being the removal of the sewage and manu-

facturing wastes of the cities and towns on the Merrimack River above Lawrence.

The results of the investigations of this Department with reference to this question show that the cost per million gallons of maintaining the city filters has not increased in the last 20 or more years since the works were constructed, notwithstanding the gradual growth of the cities and towns above Lawrence, and that there has been no material change in that time either in the efficiency of filtration or in the general character of the filtered water. This condition is doubtless due chiefly to two circumstances: (1) the enormous dilution of the polluting matter entering the stream during the wetter part of the year when the amount of pollution is very small as compared with the whole flow of the river, and (2) the effect of the great millpond extending for nine miles above Lawrence which evidently has a great purifying effect in the drier part of the year upon the polluting matters which enter at its upper end.

The removal of the sewage and manufacturing wastes from the river, judging from these results, would not be noticeable either in reducing the cost of care of the filters or in improving the quality of the filtered water at the present time. With the growth of population within the watershed, the quantity of sewage and other polluted drainage requiring disposal will increase, but, judging from past experience, the number and capacity of works for treating these wastes will also increase though not perhaps at an equal rate. If the increase in the number and capacity of treatment works does not keep pace with the growth in population, there will doubtless eventually come a time when the effect of the pollution of the river will become noticeable in the operation of the filters.

The third question — "If sewage and trade wastes are not treated or removed, what, in the opinion of your Department, will be the probable condition of the Merrimack River water at Lawrence thirty years hence?" — does not admit of a definite answer because it is impracticable to determine the growth of population in this valley or the extent and character of the manufacturing industries that may be maintained or established there in future years. If the growth of population should continue as in the past and if the industries should continue to be of much the same character and the processes remain the same, while the works increase in size at about the rate of the past thirty years, the river would become more polluted. On the other hand, if the increase in the introduction of works for the treatment of sewage and manufacturing waste already begun should keep pace with the growth in population and manufacturing, the pollution of the river would not increase, and if the introduction of treatment works should become more rapid than the growth in population and manufacturing, the pollution of the river would decrease.

The fourth question — "What is the exact condition of the Merrimack River water at the present time before filtration and what is its condition after filtration?" — is best answered by the results of the analyses of the waters of the river and the effluents of the filters, which are summarized in the various tables appended hereto. The river before filtration shows very little increase in organic matter as compared with previous years, while the effluents of the filters, as shown by the tables, are probably as safe now as at any time since these

filters were first put into operation. There is a slight tendency to an increase in the number of Bacillus coli in the filtered water in recent years, and the water from the part of the old filter not yet reconstructed is affected by the presence of iron in large quantities due to the infiltration of ground water from the soil in which the filter is constructed. These conditions are due chiefly to the character of the present filters and to the fact that they have become in recent years inadequate for the work required of them.

Summaries of the results of analyses of the water of the Merrimack River and of records of the results of the operation of the Lawrence city filter are appended. The Department has already afforded your engineer every facility for securing the detailed information on which these tables are based, together with other information relating to the water supply of Lawrence and other municipalities.

The Department does not at the present time undertake to advise you relative to the future water supply of Lawrence, since you are now preparing a report on that subject. When this report is available, it is assumed that your proposed plans will be presented to this Department for consideration and advice.

North Andover.

In response to an application from the Board of Public Works of North Andover for advice as to the use of the fire pump in the mill of M. T. Stevens and Sons Company for supplying the town with water in case of emergency, the Department, under date of June 29, 1917, replied as follows: —

The results of the examination show that the proposed emergency intake is located just above the dam in the long arm forming the outlet of the pond, which is crossed by two highways and a railroad. Two streams enter this arm of the lake, one of which, known as Sucker Brook, drains a rather sparsely settled territory and discharges into the outlet arm of the lake about a mile above the proposed intake; the other, known as Town Brook, flows through the thickly settled portion of the village of North Andover and joins the outlet arm of the lake about a quarter of a mile above the intake. The latter stream receives an overflow of sewage from cesspools at several dwelling houses, together with other drainage, and the stream also flows through a large cesspool which receives the sewage of fifteen or more tenements. Chemical and bacterial analyses show that this stream is very badly polluted and that it pollutes badly the water of the mill pond just above the proposed intake. Under the circumstances, if water were taken for emergency use from the intake at the Stevens Mill as proposed, it would probably be very injurious to the public health.

In the opinion of the Department, the fire pump at the mill of the M. T. Stevens and Sons Company should not be connected with the town water supply pipes, and no water from any mill pond on Cochichewick Brook should under any circumstances be allowed to enter the water pipes of the town.

Peabody.

In response to a communication from the Board of Health of Peabody, stating that complaints were being made of the condition of the city water, the Department, after examinations of the sources of supply, made the following reply on June 7, 1917: —

The results of these examinations show the presence of microscopic organisms of kinds which have been known to impart to the waters of ponds and reservoirs a disagreeable taste and odor. The organism which is probably the chief cause of the objectionable taste and odor complained of is *Uroglena*, which was found to be present in practically all of the samples examined. These organisms carry small globules of oil, which imparts to the water the objectionable taste and odor of which complaint is made.

The cause of the appearance and growth of such organisms in the waters of ponds and reservoirs is not known, nor is the Department able to advise you of any efficient and safe method of preventing the appearance of such organisms in your sources of water supply, or the disagreeable tastes and odors which they produce. While their presence makes the water very objectionable, the use of water containing these organisms is not known to be injurious to health. The organism *Uroglena* occurs usually during cold weather and will probably disappear as soon as the temperature of the water increases.

The most satisfactory method of removing the effects of such organisms is by filtration of the water, but their presence in considerable numbers in the ponds used for the water supply of Peabody is so rare that it would hardly be advisable to filter the water for this cause alone. Such organisms are sometimes removed by the application of copper sulphate, but this method has resulted in some disagreeable experiences and is not recommended. Experience in other places which have been similarly affected indicates that less complaint is likely to occur if all flushing of water pipes is omitted until the organisms have disappeared from the waters of the ponds, or at least from one of them, which should then be used as the source of supply until the organism disappears from the others.

Salem.

On June 4, 1917, the Salem and Beverly Water Supply Board requested information as to the effect of pumping Ipswich River water into Wenham Lake upon the condition of the lake water, and as to the need of filtering this water for the supply of Salem and Beverly, and on June 7, 1917, the Department replied as follows: —

It appears that the total quantity of water pumped from Ipswich River to Wenham Lake in the months from December to May, inclusive, in the years 1916 and 1917, has amounted to 620 million gallons and that during a part of this time water has been admitted to the lake from Longham Reservoir as usual.

A comparison of the results of analyses of the water of Wenham Lake in the period from December 1916 to May 1917 with those of similar periods in earlier years indicates that the color of the water of Wenham Lake has been no greater than in the years before water was taken from the Ipswich River. The same is true of the other determinations of the chemical analysis of the water of the lake.

Bacterial examinations of the lake water show that the numbers of bacteria have remained low since the introduction of water from the Ipswich River and that the number of B. coli present has not been greater than in corresponding periods previous to the use of water from that source.

Summarizing the results of the analyses, it appears to the Department that there has been no deterioration nor material change in any respect in the condition of the water of Wenham Lake since water was drawn from the Ipswich River as compared with its condition in previous years, and the water is, in the opinion of the Department, safe for drinking. In view of these results, the Department sees no present need of installing filters for the treatment of this water, and the question of filtration may safely be postponed for consideration at a later time after there has been opportunity for further experience in the effect of Ipswich River water on Wenham Lake.

South Hadley (Mount Holyoke College).

In response to an application from the treasurer of Mount Holyoke College for advice relative to the treatment of the water supplied to the college, the Department advised as follows on Aug. 14, 1917: —

The State Department of Health has considered your application for advice as to whether the water from the Upper Pond, so called, on Muddy Brook can be made absolutely safe and agreeable to the taste after treatment by means of mechanical filters, using alum, soda ash and chloride of lime, if this water is supplied for drinking and other purposes in Mount Holyoke College, and has examined the report of your engineers presented therewith. The Department has also caused the watershed of Upper Pond and Muddy Brook to be examined by its engineer and has considered the conditions affecting the public water supply in South Hadley Center which is also available for the use of the college.

It appears that drinking water is supplied in Mount Holyoke College from a deep tubular well and that water for general purposes in the buildings is taken from Muddy Brook, while some of the dwelling houses connected with the college are supplied from the works of the South Hadley Fire District No. 2. The watershed of Muddy Brook above Upper Pond, though rather sparsely inhabited, contains considerable areas of land under active cultivation and the streams are exposed to danger of pollution at the present time. It is inadvisable, in the opinion of the Department, to attempt to enforce sanitary rules and regulations for the protection of this watershed for the present purpose, and under the circumstances the water is likely to continue to be exposed to danger of pollution and to be subject probably to sudden and considerable changes in character from time to time. The filtered water after the treatment proposed will doubtless

nearly always be of good appearance and suitable for most of the purposes for which considerable quantities of water are used in the college, but it will be less safe than the water supplied through the works of the South Hadley Fire District No. 2 and is likely also to be considerably harder and less satisfactory in other respects than the water supply of the District. It appears to the Department important that the college shall be supplied with the best water available and, under the circumstances, the Department recommends that all water used for drinking and cooking in the college be taken from the works of the Fire District.

The filtered water will be nearly always of good appearance and will be suitable for bathing, flushing, washing, irrigation, etc., — that is, for most of the purposes for which considerable quantities of water are required, but this water should not be supplied where it may be used for drinking and cooking.

Sturbridge.

Under date of Feb. 2, 1917, the Department replied as follows to the request of the Board of Water Commissioners of Sturbridge for advice relative to a water supply for the town, after an examination of the localities in which tests had been made, namely, the White Farm, the Rudiger Farm, Locke's Meadow and the Hubbard Meadow: —

At all of these places water was obtained very freely from the test wells. The water at Hubbard Meadow is somewhat harder than the others, probably being affected somewhat by the nearness of the test well to populated areas in Sturbridge. At Locke's Meadow water of good quality was obtained, but the ground in this location is somewhat higher than desirable, a condition which makes less certain the probability of an adequate quantity of water being obtained there. At the White Farm, located a short distance below Fiskdale, water of excellent quality was obtained very freely from the test wells, and the conditions were favorable for obtaining an adequate quantity of water for the supply of the town in that location.

At the Rudiger Farm the conditions north of the highway near the southerly end of Cedar Pond were unfavorable, the test wells driven there yielding very little water, but south of the highway the tests were found to be very favorable for obtaining a large quantity of ground water and, excepting in one well, the water of which appeared to be affected slightly by local conditions, the indications are that water of good quality can be obtained in this region.

The wells at the Rudiger Farm could be located at a greater distance from the more thickly populated parts of the town than would be the case at the White Farm, and, all things considered, the Rudiger location appears to be the most favorable one of all of those under consideration in which to locate a water supply. Considering the circumstances, the Department recommends that a further and thorough test be made at the Rudiger Farm to determine the practicability of obtaining an adequate quantity of good water at that location for the requirements of the town. For this purpose, the Department recommends that a test

be made by sinking several wells, connecting them to a steam pump, and pumping from them continuously for a period of at least a week at a rate of 200,000 to 300,000 gallons per day. During this test, observations of the height of water in observation wells in the neighborhood of the test wells should be made at frequent intervals, and these observations should be continued for a week or more after the completion of the test. In locating the wells for this test, it is advisable to place them west of the brook leading from Cedar Pond to the Quinebaug River and as near as practicable to the base of the higher land on the east side of the brook.

The Department will, if notified, make the necessary analyses of water while the tests are in progress to determine the probable permanent quality of the ground water in this region and will give you further advice in this matter when the results of these tests are available.

On April 20, 1917, an application was received from the Board of Water Commissioners of Sturbridge for approval by the Department of the taking of a water supply for the town from the ground on the easterly side of the brook flowing from Cedar Pond to the Quinebaug River. After an examination of the results of a pumping test from a group of wells in this region, the Department, under date of May 11, 1917, replied as follows: —

For the purposes of this test ten test wells were sunk in the region indicated which varied in depth from 25 to somewhat more than 36 feet, with an average of 28 feet 10 inches, all of which yielded water very freely when pumped with a hand pump. Eight of these wells were subsequently connected with a steam pump for the purpose of a pumping test and water was pumped continuously from the wells for a period of six days, starting at an average rate of about 600,000 gallons per day and continuing at varying rates averaging 480,000 gallons per day for the period of the test. Observations of the height of the ground water were made in various test wells in the region about the group connected with the pumps, the results of which showed that the ground water was not lowered materially while the test was in progress and recovered in a very short time after pumping ceased.

The results of this test indicate that an ample supply of water for all the requirements of Sturbridge can be obtained without difficulty from the ground in this region, even though the population should become much greater than at the present time.

In order to determine the quality of the water obtainable from the ground in this region, samples of water were taken for analysis from several of the test wells and samples were collected daily from the group of wells connected with the pump while the test was in progress. The results of the analyses show that the water is very soft, very low in organic matter and iron, and in all respects of excellent quality for the purposes of a public water supply.

In view of the results of these investigations, the State Department of Health, acting under the provisions of Chapter 287 of the Special Acts of the year 1917,

hereby advises the taking of water for the supply of the town from the ground in this region and approves the location of wells in the region of the test wells as sources of water supply for the town. The Department recommends that a sufficient area of land be acquired in this region to prevent the location of dwelling houses or other buildings in the region about the wells which might tend to affect unfavorably the quality of this water supply.

Templeton (Hospital Cottages for Children).

Under date of Jan. 22, 1917, the Department replied as follows to a request from the superintendent of the Hospital Cottages for Children at Baldwinsville for advice as to increasing the water supply of that institution: —

An additional supply of good water is greatly needed for the purposes of this institution and should be provided without delay. Judging from the yield of the Page well and the conditions in its neighborhood, however, it is not probable that a very considerable additional supply can be obtained from the ground in that region, nor would it be advisable to drive any additional wells in the vicinity of the deep tubular well, the water of which is objectionable on account of an excess of iron.

A general examination of the grounds of the institution indicates that the most favorable location for wells is found in the neighborhood of the upper end of Depot Pond, so called, in the southwesterly part of the institution grounds, where it is probable, judging from surface indications, that a sufficient supply of water for all the needs of the institution can be obtained from the ground. The most favorable conditions, judging from surface indications, for obtaining water from the ground are found along the northerly side of the pond, but there is danger that the water in that region may be affected by drainage from the cemetery and from the sewage filtration area of the institution.

Under the circumstances, it will probably be best to make tests along the easterly side of the pond near its upper end to determine whether an adequate supply of good ground water can be obtained in that locality. If it is not found practicable to obtain water of good quality and in sufficient quantity for the requirements of the institution at this location, it is not unlikely that a supply will have to be sought in some location outside of the institution grounds. If it is decided to make further investigations for a water supply in the region indicated, it is advisable that tests be made by means of tubular wells sunk to a depth of not more than 30 feet, and it is not advisable to sink wells in rock since they are unlikely to give satisfactory results.

The Department will assist you in the investigations for an additional water supply by making the necessary analyses of water and will give you further advice in the matter, if you so request.

Templeton (Massachusetts School for the Feeble-minded).

Under date of Jan. 20, 1917, after an examination of the sources of water supply of the various groups of buildings at the Templeton Colony of the Massachusetts School for the Feeble-minded, the Department replied as follows to a request from the Commission on Mental Diseases for information as to the condition of the water supply at that institution: —

The water supplies of the various groups are obtained from ordinary wells about 8 to 12 feet in diameter and 12 to 16 feet in depth. At the Eliot Colony the water is obtained from three such wells located north of the buildings where the soil is quite fine and the quantity of water obtainable is limited. The territory draining toward these wells is treated at times with barnyard manure and other fertilizers, and the water shows the effect of pollution from this cause. In the condition in which it was found at the time of the recent examination this water, though quite hard, was probably safe for drinking.

At the Brook Colony the water is obtained from a well located a short distance south of the buildings where the soil is somewhat less unfavorable for obtaining water than at the places where the wells of the other buildings are located. The ground draining toward this well does not appear to have been treated with fertilizer and the water is very soft and in other respects of excellent quality for domestic use.

At the Narraganset Colony the water supply is obtained from a well located south of the buildings, the water of which also appears to be affected by the fertilizer deposited on the ground about it, resembling very closely in character that of the Eliot group.

The water supply of the Farm House Colony is obtained from a well located north of the buildings, and the water of this source is also affected by fertilizers deposited upon the ground in its neighborhood. This water is in consequence very hard, though the number of bacteria present was insignificant.

If the wells in question continue to furnish an adequate supply of water for the requirements of the various groups of buildings which they are designed to serve, their use may safely be continued for the present, but the deposit of fertilizer upon the ground about them or draining in their direction should be discontinued at once. Otherwise the quality of the water of these sources is likely to deteriorate seriously and become unsafe for drinking.

If the water supplies of any of these buildings become inadequate, as is likely to be the case if the number of inhabitants at this institution is increased, it will probably be advisable to provide a general system of water supply for all of the buildings, and the works should be made large enough so that an ample supply of water will be available for the irrigation of crops as well as for domestic purposes, since it appears that extensive farming operations are carried on at this institution. The conditions in the valley of Beaver Brook, flowing through the westerly part of the grounds of the institution, appear to be favorable in places

for obtaining a ground water supply, and whenever a general system of water supply becomes necessary it would be advisable to obtain a ground water supply from the valley of this brook if practicable.

Uxbridge.

In response to a request from the Board of Water Commissioners of Uxbridge for advice as to the probable effect of raising crops on land about 300 feet from the wells from which the town water supply is drawn, this land having been purchased for the purpose of protecting the water of the wells, the Department made the following reply on April 30, 1917: —

While no thorough studies have been made to determine definitely the probable quantity of water that flows from this region toward your wells, it is probable, judging from a general examination of the locality, that ground water from this land drains toward the wells.

Under these conditions, the use of fertilizers on these lands for the growing of crops would undoubtedly, in the opinion of the Department, have an injurious effect upon the quality of the water of your wells. While this effect would probably not be sufficient to cause injury to health, at least in the immediate future, the injury done by cultivating this land might be serious, if not permanent, and of much more importance than the advantage to be gained from the use of this particular lot of land for the purpose proposed. Under the circumstances, the Department does not recommend the cultivation of this land or of any of the lands controlled by the town for the protection of its water supply.

West Springfield.

On March 6, 1917, the Department sent a communication to the Board of Water Commissioners of West Springfield approving the taking of eleven parcels of land within the watershed of Bear Hole Brook, the acquisition of these lands being necessary for the protection of the purity of the water of Bear Hole Brook, one of the sources of water supply of the town of West Springfield.

Winchester.

In reply to a request submitted by the Winchester Water and Sewer Board for assistance and advice from this Department in improving the condition of the water supply of the town, situated in Middlesex Fells, the following communication was sent to the Water and Sewer Board of Winchester and the Metropolitan Park Commission on Aug. 30, 1917: —

The Winchester Water Board has submitted this question for advice in a communication dated July 17, 1917, and annexed hereto and marked "A".

With this communication the Water Board has sent specifications of acts of contamination running over the period from June 30, 1917 to August 19, 1917, which show that during that period the public frequenting the recreation grounds have continually polluted the reservoir and its tributary.

The Winchester Water Board on June 26th, 1917, enclosed reports up to that date regarding the conduct of visitors to the Metropolitan Play Ground adjoining this water supply reservoir, and stated that they could not allow the conditions to continue and requested the Metropolitan Board to join with it in putting an effectual stop to it and suggested a conference between the two Boards in order to form a plan to prevent such conduct as was reported. In accordance with this a conference was arranged for on July 11th at the office of the Metropolitan Park Commission. The Winchester Water Board, as is shown by its communication of July 17th, wishes to avoid publicity, and had not on the date of its letter applied to the local Board of Health or Town Council, or other town officials, in the matter.

Their appeal is made to this Department with the approval of the Metropolitan Park Commission, in order that the matter may be set right, and this Department is appealed to to take such action or give such advice as would best bring about a proper solution of the whole matter without more public discussion than is necessary to produce results.

A copy of the agreement made between the Winchester Water & Sewer Board and the Commonwealth of Massachusetts Metropolitan Park Commission, dated July 22, 1912, providing for the transfer for care, control and custody, including police protection, of 405 acres of land, more or less, owned by the town of Winchester and then controlled by the Winchester Water & Sewer Board, situated partly in said town of Winchester, partly in the town of Stoneham and partly in the city of Medford, all in the County of Middlesex, the greater portion of said parcel lying within the limits of and surrounded by the Middlesex Fells Reservation, has been sent to this Department for reference.

After the description of the real estate transfer, the agreement runs as follows:

> This transfer is made with the express understanding and reservation that the party of the first part, its agents, servants and employees shall at all times during the continuance of said agreement have the right to go upon the land above described and the water reservoirs and water supplies therein for the purpose of caring for the shores of said reservoirs, maintaining the purity of said waters, and the doing of any work in connection with said reservoirs and water supplies.
>
> This transfer is also made with the express understanding and agreement that in exercising police control and protection in and over the premises herein described, the party of the second part shall in particular make and enforce its own or such other rules, regulations, ordinances, and laws as it may deem necessary to prohibit any person from entering upon such premises for the purpose of cutting or taking ice and from cutting or taking of ice from such premises, and from fishing in, or sending, driving, or putting any animal in the waters of the reservoirs within said premises, and from entering or going in any boat, skiff, raft, or other contrivance on or upon the waters of such reservoirs, and from entering or going upon, or driving any animal upon the ice on the waters of such reservoirs.
>
> This agreement may be terminated at any time by either party hereto upon thirty (30) days notice in writing signed by a majority of the persons forming for the time being said party giving such notice, or by a vote of the town of Winchester at a meeting duly called and held for the purpose.

And said party of the second part in consideration of the transfer herein made, doth hereby accept the care and control, including police protection, of the parcel above described for the purposes and under the powers herein set forth or referred to.

It is necessary, for the protection of the water supply of Winchester, that these acts of pollution should not continue. The transfer referred to above put the responsibility for the care, control and custody, including police protection, of the land transferred, upon the Metropolitan Park Commission, so long as the agreement of transfer is in force.

And it was specially agreed, as indicated above, that in exercising police control and protection in and over the premises described, the party of the second part shall make and enforce its own or such other rules, regulations, ordinances and laws as it may deem necessary, to prohibit any person from entering upon such premises for the purpose of cutting or taking ice, fishing in, sending animals into the water, from boating, from entering or going in any boat, skiff, raft, or other contrivance on or upon the waters of such reservoirs or from entering or going upon or driving any animal upon the ice on the waters of such reservoirs.

The enumeration of these particular forms of nuisance to be prevented does not exclude from the responsibilities of police protection the preventing of such particular acts of nuisance as are enumerated in the specifications of complaints submitted by the Winchester Water Board.

And it seems evident that the full intent of this agreement is to put upon the Metropolitan Park Commission the full responsibility for keeping pollution from the waters of the reservoir. The Water Board's only rights in the matter are to enter the land and the water reservoirs and supplies to care for the shores and maintain the purity of the water and to do any work in connection with the reservoirs and water supply, but no duty of police protection is included in these actions.

The vote of the town authorizing the transfer which is annexed to the agreement empowered the Water Board "To transfer and set over unto the Metropolitan Park Commission the care control and custody including the police protection of lands controlled by the Winchester Water & Sewer Board," and the vote provided that "Any such transfer shall contain a provision that it may be terminated at any time by either party thereto upon 30 days notice in writing signed by a majority of the persons forming for the time being said party, or by a vote of the town of Winchester passed at a meeting duly called and held for the purpose."

Except for the dispute which has arisen from these acts of nuisance, the arrangement seems to have been for the benefit of the town and of the public; the town being saved the expense of police protection of its waters, and the public having the benefit of a large tract of land for recreation purposes. The last use, however, should not be permitted to prevail if it cannot continue without pollution of the reservoir.

The Winchester Water Board is of the opinion that the only way to permanently abate the annoyance is to move the play ground, or a portion of it, whether from the immediate vicinity of the reservoirs or the brooks which feed them.

The Park Commission, however, does not agree with this contention, and while it has put more policemen on the ground during the day time, to the betterment of conditions, it has declined to erect or pay for any part of a fence to separate the play ground from the town of Winchester property.

It also claims not to be responsible for the violation of the sanitary rules governing the Winchester water supply territory, established by the State Board of Health April 1, 1909, but it did not object to bring the matter to the attention of this Department.

The sanitary rules made by this Department must be enforced. The obligation is primarily upon the Winchester Water Board, and it cannot, by a transfer to any other authority, escape from it. It is the opinion of this Department that the Water Board should at once proceed to enforce the sanitary rules by their own agent and continue this until the dispute between it and the Metropolitan Park Commission in regard to the duties of the latter Board under the agreement is settled.

On Dec. 20, 1917, the following communication was sent to the Water and Sewer Board of Winchester in response to their application relative to the protection of the water supply of that town: —

The plan for the protection of the water supply, suggested in a letter submitted with your application, is as follows:

. . . 1. Remove from their present location near the brook and reservoir the playground apparatus, sand boxes, lunch tables, etc., except for the present the swings (the swings will be left for the present, as it is said to be hard to find an appropriate place for them. If they cause trouble, they can be removed later.)

2. The sanitaries are to be increased.

3. Signs directing to the sanitaries and prohibiting conduct likely to harm the reservoirs will be furnished wherever advisable and will be printed in the various languages necessary. This is an important change, as hitherto only English has been used and a large part of the users of the playground do not understand it.

4. Pipe a brook from the swamp to the reservoir some one thousand feet. This is the brook which has been most abused.

5. Fence the shore of the reservoir for nearly a mile. The suggestion is for a suitable wire fence six feet high on wooden posts with signs at proper intervals.

6. Additional police on Sundays and holidays.

7. Place the required funds in a special maintenance item before the Legislature. Mr. Barton for the Commission will speak for the appropriation before the legislative committee. We are to back the bill, securing the aid of the State Department of Health, etc. . . .

It appears that the town of Winchester originally acquired a considerable area of land about the shores of its reservoirs, viz., of the North, Middle and South reservoirs, in order to protect them from pollution.

The watersheds of the Winchester reservoirs contain no human habitation, a portion of the watershed of the North Reservoir having been diverted many years ago in order to remove danger of pollution from a section of the town of Stoneham. But the reservoirs are located within the limits of the Middlesex

Fells Reservation, so called, controlled by the Metropolitan Park Commission, and an electric railway line brings several thousand persons into the watershed on Sundays and holidays, and these persons wandering through the watershed of the Winchester reservoirs and along their shores have caused most serious pollution of these waters, especially those of the North Reservoir. The water of this reservoir is supplied directly to the town of Winchester for domestic use and the pollution of its waters endangers the health of a large part of the town.

It appears that several years ago the town of Winchester leased the control of its lands about the Winchester reservoirs to the Metropolitan Park Commission subject to certain conditions, including the policing of these lands in order to protect the Winchester water supply, but it is evident from the inspections of the past year that, however efficient this policing may have been, it did not serve to prevent the pollution of the North Reservoir.

The plans presented for relieving the pollution of the Winchester water supply appear to this Department to be inadequate for the purpose. The removal of certain of the playground apparatus will presumably remove some of the attractions in the immediate location, but, since a part of the apparatus is still to remain at least for a time, the proposed change is not likely to be of any great value. The increase in sanitaries means an increased quantity of sewage gathered within the watershed which will require proper disposal. Piping the brook from the swamp to the reservoir would prevent the direct pollution of the brook, but the water falling on the ground tributary to this brook must find an outlet eventually into the reservoir, and, even if the brook were covered, deposits of objectionable matter on the ground would inevitably drain to the brook and ultimately to the reservoir. Fencing the shore of the reservoir would keep visitors to the park from having access to the reservoir. The fence, however, should not be located on the immediate shore of the reservoir but at as great a distance therefrom as practicable.

The whole difficulty in this matter appears to the Department to be caused by the attempt to use a water supply reservation as a recreation ground. The town of Winchester many years ago wisely purchased the land about its reservoirs in order to protect them from pollution and also sacrificed a considerable part of the watershed of one of the reservoirs in order to remove danger of pollution from the town of Stoneham. But after taking these precautions, several thousand persons are now admitted to the watershed and the shores of the reservoirs on Sundays and holidays in the warmer part of the year, with the inevitable consequence that the reservoirs are badly polluted.

In the opinion of the Department, the effective protection of the water supply of the town of Winchester requires that the rules and regulations established by this Department under the authority of law for the sanitary protection of this watershed shall be thoroughly enforced by the town of Winchester at all times within its limits.

The Department will be pleased to advise you further at any time as to the precise measures to be taken from time to time for the effective protection of the Winchester water supply.

SEWERAGE.

Belchertown (State School).

On July 18, 1917, the Department sent the following communication to the Commission on Mental Diseases in response to their request for advice relative to a plan of sewage disposal for the Belchertown State School: —

The best plan of disposing of the sewage of the institution will probably be to discharge it upon sand or gravel filters located in the neighborhood of the brook in the northerly part of the institution grounds. The tests made in this region show that porous soil suitable for the purification of sewage is found in the neighborhood of the brook, and it is probable that filters of adequate capacity for the treatment of the sewage can be constructed without special difficulty in this valley. With properly constructed sand filters, it would be practicable to purify the sewage of the institution sufficiently to prevent danger of producing a nuisance in the brook, but the filters should be constructed at sufficient elevation to provide for secondary filtration in case the conditions in the stream ever become such that a high degree of purification of the sewage becomes essential.

Bridgewater.

On July 11, 1917, an application was received from the Board of Selectmen of Bridgewater for the approval of the system of sewerage and sewage disposal of the town of Bridgewater, and on July 30, 1917, the Department replied as follows: —

Upon receipt of your application of July 11, 1917, for the approval in some form of the system of sewerage and sewage disposal of the town of Bridgewater, the facts were submitted to the Attorney General and his opinion requested as to whether the discharge of sewage into the Town River by the town of Bridgewater would be a violation of Revised Laws, Chapter 75, Section 124, and also whether this Department could advise the temporary discharge of sewage into the river in the neighborhood of your present outlet, pending the construction of sewage disposal works by the town.

The Attorney General has now submitted an opinion which indicates clearly that, in view of the use of water from the river by the Bridgewater State Farm in a manner described, this Department cannot recommend or advise the discharge of untreated sewage from the Bridgewater sewers either permanently or temporarily into the Town River.

Chatham (United States Coastal Air Station).

Under date of Oct. 18, 1917, the Department sent the following communication to Lieut. F. N. Bolles, U. S. N., in response to a request for advice as to plans of a system of sewerage and sewage disposal for the Coastal Air Station at Chatham: —

The plans provide for collecting the sewage into a tank having a capacity of 20,600 gallons and discharging it thence to a sub-surface filter 0.5 of an acre in area to be constructed in the eastern part of the grounds near the seashore. The proposed filter is to be constructed by removing the soil and sub-soil from the ground at the locality indicated and providing a filter of sand having a surface elevation 3 feet above maximum high water. Upon this filter a system for distributing the sewage is to be laid consisting of 4-inch pipes laid 10 feet 9 inches on centers in a layer of broken stone or coarse gravel 6 inches in depth with a layer of finer gravel above, upon which will be filled soil and sub-soil up to a maximum depth of about 1.75 feet above the surface of the sand. This filter is to be divided into two beds, and the sewage is to be discharged to the distributing pipes from a dosing tank having a capacity of about 10,250 gallons with a main pipe 12, 10 and 8 inches in diameter extending through the center of the beds and connecting with the 4-inch distributing pipes.

As a result of the examination of the locality, it appears that the area selected for sewage disposal is the best available within the limits of the grounds of the station, and, in the opinion of the Department, if the proposed works are properly constructed of the suitable material available under the supervision of an engineer of experience in such matters, they will provide adequately for the disposal of the quantity of sewage that may reasonably be expected from a station of this size for a considerable time in the future. When it becomes necessary to enlarge the filters, they can be extended in a westerly direction without serious difficulty. Sub-surface filters are essential in this location in order to avoid nuisance from objectionable odors, but such filters inevitably become clogged after a longer or shorter period of use and it then becomes necessary to dig up, clean and relay the distribution system. The length of time that the filters will serve without relaying is uncertain, depending largely upon efficiency in their construction and upon the quantity of sewage produced at the station.

Under these circumstances, it is very important that observations of the height of water in these filters be kept from the time of their construction and that their operation be continued under the supervision of an engineer of experience in such matters, in order that any danger of overcharging the filters may be detected and suitable measures taken for preventing danger of pollution of adjacent waters.

With the precautions herein suggested, which in the opinion of the Department are highly important, viz., the construction and subsequent supervision of the operation of the works by an engineer of experience in such matters, with observations of the height of the ground water in and about the filters, and

with the enlargement or renewal of the filters promptly whenever it appears that they are likely to become inadequate for the proper purification of the sewage, the Department is of the opinion that the plan proposed is a reasonable one to adopt for the disposal of the sewage of this station.

Deerfield (Deerfield Academy).

In response to a request for the consideration of the Department of a plan for a sewer to receive the sewage of the Deerfield Academy and discharge it into the Deerfield River, the Department, under date of May 11, 1917, replied as follows: —

An examination of the locality indicated that the proposed outlet of this sewer would probably be unsatisfactory, and the plan as subsequently revised and as finally presented provides for the collection of the sewage from at least three, and possibly other, buildings along Albany Road west of Main Street and for discharging it into the easterly arm of the Deerfield River near the ford on the old Albany trail.

The plan of discharging crude sewage untreated into the Deerfield River can only be considered as a temporary one, but, in view of the small quantity of sewage, the Department is of the opinion that the method of disposal proposed is permissible for the present. It has been impracticable to make a satisfactory examination of the locality at the present season of the year, but the location of the outlet now proposed appears to be the best that it is practicable to adopt.

The plan presented will provide only for the sewerage of the street in which the sewer is to be located, but the sewage of the remaining portions of the village can be collected by means of sewers which can be eventually joined to the one now proposed and all of the sewage conveyed to a common outlet when necessary.

Under the circumstances, the Department is of the opinion that the plan of discharging sewage from the proposed sewer into the Deerfield River at the point shown on the plan presented is a permissible one, the use of this outlet to be discontinued at such time as the State Department of Health may designate after notice, and to be discontinued in any case whenever a general system of sewerage has been adopted by the town for this village or any part thereof.

Foxborough (State Hospital).

Under date of Dec. 20, 1917, the Department sent the following communication to the Commission on Mental Diseases, after a consideration of plans of sewage disposal at the Foxborough State Hospital submitted by them, the location of the works having already been recommended by the Department on Nov. 29, 1916: —

The plans presented provide for abandoning the existing filter beds and conveying all of the sewage from the hospital through a 12-inch sewer to a screen

chamber and thence to 24 sand filter beds having a total area of 5.5 acres, from which the effluent would be discharged into the Neponset Reservoir.

At the location of the proposed filter beds there appears to be an ample quantity of material for the purpose. Some of the sand is rather fine, but by selecting the coarser sand excellent filter beds can be constructed therefrom. The proposed area is ample for the disposal of all of the sewage which is likely to be discharged from this institution with its proposed development.

The plans provide for an adequate system of distribution of the sewage upon the filters and for very thorough underdrainage. Provision has been made in the plans for the construction of a dosing tank, if it shall be found necessary, at a drop manhole on the main sewer near the old filter beds. The plans as a whole, in the opinion of the Department, provide adequately for the purification of the sewage of this institution, and the Department recommends that the works be built as planned at the earliest practicable time.

Framingham.

In response to a request from the Board of Public Works of Framingham as to the effect of the discharge of wastes from a machine works into the Framingham sewers upon the sewerage system of the town, the Department caused an investigation to be made of the character of such wastes discharged from similar works and made the following reply on March 31, 1917: —

The results of this investigation show that, at most of the places examined, the processes carried on are probably not quite comparable with the proposed process at Framingham; but it is obvious, from the tests made, that wastes of a similar character to those which are likely to be discharged at Framingham would have an injurious effect upon iron and cement and probably also upon Akron sewer pipe. Under the circumstances, it is not advisable to discharge wastes of this character into your sewers unless a test of the wastes themselves, when the works are in operation, shall show clearly that they are of a different character from those usually discharged at such works and will not injure sewer pipes of cement or iron.

The cooling water at the places examined appears to contain little organic matter and no considerable quantity of acid, and this water could probably be discharged into the sewers without objection so far as its effect upon the system is concerned; but the addition of such a large quantity of this water to the sewerage system as seems likely to result from the cooling process would require an increase in the area of filters used for the disposal of the sewage and a considerable increase also in the cost of pumping and of the maintenance of the filters.

It is not advisable that either the regular wastes or the cooling waters be admitted to the sewers unless it is found by definite tests, after the works are completed, that these waters can reasonably be admitted to the system.

Ludlow.

In response to a request from the special sewer committee of the town of Ludlow for advice as to additional sewerage for the town and the location of proposed new outlets, the Department considered the plans presented and made the following reply on July 30, 1917: —

The plan submitted provides for two main trunk sewers with branches having outlets into the Chicopee River about 600 and 1,150 feet respectively below the Boston and Albany Railroad bridge and about 4,200 feet above the Indian Orchard dam. The sewer having its outlet nearest the railroad is designed to extend from that point along the northerly bank of the Chicopee River, chiefly in East and State streets, to intercept the sewage now discharged at a number of outlets along that side of the river and remove it to the proposed new outlet. The other sewer, having its outlet about 1,150 feet below the railroad, is designed to serve a system of sewers draining a district in the northwesterly part of the village which is already thickly populated and growing rapidly.

The scheme in general will, when carried out, improve the conditions along the Chicopee River in this village by removing the sewage from a number of separate outlets and will provide for the sewerage of additional thickly settled areas in this village in which a system of sewerage is now needed.

As the proposed outlets will discharge into a deep basin in which there is a considerable movement of water, it is unlikely that objectionable conditions will result with the quantity of sewage likely to be discharged into the river for the present, provided the outlets are carried to a sufficient distance from shore and located well below the lowest level to which water is ordinarily drawn, and, in the opinion of the Department, the discharge of the sewage of the village at the proposed outlets is permissible under the present circumstances. It is not probable that sewage can be discharged untreated into the Chicopee River in this neighborhood without eventually creating objectionable conditions. Under the circumstances, the outlets now proposed are to be regarded only as a temporary method of disposing of the sewage, and when objectionable conditions appear, the use of these outlets for the discharge of crude sewage is to be discontinued and the sewage treated to such an extent as may be necessary to maintain proper sanitary conditions in this river.

In the opinion of the Department, the temporary outlets should be placed not less than 75 feet from shore at the points indicated on the plan submitted.

Medfield (State Hospital).

Under date of Aug. 22, 1917, the Department, after consideration of an application from the Commission on Mental Diseases for advice as to sewage disposal at the Medfield State Hospital and the plans submitted therewith, replied as follows: —

Plans similar to those now presented for the consideration of the Department, providing for the abandonment of the present settling tank and the construction

of an Imhoff tank, dosing tank and additional filter beds aggregating in area about 0.6 of an acre, were submitted by the State Board of Insanity early in 1916 and, after consideration, the Department advised that the area of the filters be increased 2.3 acres, making the aggregate area 5 acres, and that the construction of the settling and dosing tanks proposed in the plans presented be postponed until experience in the operation of the works recommended has shown whether the additional treatment by means of the proposed tanks is essential for the proper and efficient disposal of the sewage.

The Department has examined the revised plans now presented and the further information submitted relative to the quantity of sewage requiring treatment. Recent measurements indicate that this quantity is considerably less than that used as the basis of the former recommendations of your engineers but, in view of recent indications that there is likely to be a material increase in the population of the institutions devoted to the care of the insane, the Department recommends that the full area of filters recommended in the beginning be constructed and that the Imhoff tank, dosing tank and sludge filters be omitted for the present. It is advisable that screens be provided whereby the sewage can be screened before its discharge to the filters, but the further use of the present settling tank and sludge beds should be discontinued, as recommended by your engineers, and the remaining portion of the works repaired and placed in condition for the most efficient operation.

The following reply was also sent to the Commission on Mental Diseases on Dec. 20, 1917: —

The recent report of Messrs. Metcalf & Eddy relative to Medfield State Hospital sewage disposal submitted by you to the State Department of Health contains a summary of the estimated total cost of the various projects for sewage disposal on page 8 as follows:

1. Original project, including Imhoff tank, dosing tank and 1.2 acres of additional filter beds adjacent to the present beds, ...	$24,250
2. Revised project dictated by the State Department of Health, omitting Imhoff tank and dosing tank and constructing 2.34 acres of additional filter beds adjacent to present beds, ...	25,817
3. Project suggested by Dr. Kline, including sewer to piggery site and construction of 2.4 acres of additional filter beds (Project I), ...	25,546

The report also contains an estimate of the cost of another project known as project No. 2, which provides for laying a sewer on a more direct route from one of the existing sewers to the piggery site. The estimated cost of this project is given in the report as $25,252, to which an allowance of $2,500 for ledge is added, making the total estimated cost $27,752.

It will thus be seen that the cost of the various projects ranges from a minimum of $24,250 to a maximum of $27,750, or, leaving out the allowance for ledge in the last-named project, the estimated cost of the four projects varies from $24,250 to $25,817; that is, according to these estimates, the most expensive project would cost 6.5 per cent. more than the least expensive one. In view

of the rapid variations in the price of all materials and in the price of labor that are taking place at the present time, the differences in these estimates are, in the opinion of this Department, wholly negligible, and it is reasonable to assume that the cost of the various projects as presented is likely to be practically the same, if done by contract. It, therefore, remains to determine which of these projects will be the more advantageous for the hospital to adopt from other points of view.

In the original project (numbered 1 above), including the Imhoff tank and 1.2 acres of filter beds, and in the revised project so called (numbered 2 above), omitting the Imhoff tank and dosing tank and constructing 2.34 acres of additional filter beds adjacent to the present filter beds, it would be necessary to haul practically all of the sand from the neighborhood of the piggery site to the neighborhood of the present filters, involving the construction of a road for the purpose. In both of these projects the sewage of the farmhouse is omitted, and as the cesspools at the farmhouse are objectionable, they should be included in the plan of sewage disposal if possible, since the quantity of sewage from these buildings is a considerable one and the nuisance is likely to continue to increase.

Of the two projects last named, project No. 1, so called (numbered 3 above), provides for laying a pipe from the present sewer to convey all the sewage from the entire institution by gravity to the piggery site along a line which would pass through the immediate neighborhood of the farm buildings and will be capable of receiving the sewage from those buildings.

It is likely, furthermore, that the cost of filters at the piggery site, including a new sewer from the existing sewer to the piggery site, would be less than the cost of filters in the neighborhood of the present filter beds. Nearly all the work at the piggery site can be done by inmate labor, whereas if the sand is hauled to the neighborhood of the present filter beds it will probably be necessary to employ teams and a considerable amount of outside labor.

For these reasons, it appears probable that the piggery site will have four advantages, — (1) that it will remove the nuisance in the neighborhood of the farmhouse; (2) that it will be the least expensive, especially if the estimated cost of the other projects is increased to include the disposal of the farmhouse sewage; (3) that the cost of filters at the piggery site is likely to be materially smaller if inmate labor is used; and (4) the piggery site is in a more remote location from which it is unlikely that odors will be noticeable at any building. There appears to be ample room for extending the area of the filters at the piggery site, and it will probably be best, if further difficulty is experienced with the present filters, to gradually extend the filters at the piggery site and eliminate the further use of the present area.

The successful work you are now doing in constructing filters at Foxborough with inmate labor and at a very small cost will indicate to you what may be done in a similar way by constructing filters at the piggery site.

Palmer.

In response to a request from the Board of Selectmen of Palmer for consideration by the Department of a plan of a sewer in Oak Street to receive sewage from certain houses in the lower part of that street and to discharge into the Quaboag River about 250 feet above the bridge of the Central Vermont Railroad, the Department, under date of July 18, 1917, made the following reply: —

The quantity of sewage to be discharged is small and will probably not have any very noticeable effect on the river at this location. At the proposed point of discharge, however, the river is apparently used at times as a bathing place, and the Department recommends that if the sewer is built in this location the outlet be carried farther down stream to the neighborhood of the railroad bridge and that it be so located that the discharge will take place at all times below low water in the river.

With this change the Department believes that the discharge of the sewage of Oak Street at this point is permissible for the present. It is important that in laying the sewer, as in all the sewers of Palmer, provision be made for keeping the storm water out of the sewers or for readily diverting it therefrom, in case it shall be admitted, since it is probable that at no great distant time the town will find it necessary to remove all of the sewage from the river and treat it at disposal works.

When treatment becomes necessary, it will be very important to keep the sewage separate from the storm water and ground water, since storm water, if undiluted by sewage, can continue to discharge into the river without treatment.

Randolph (Boston School for the Deaf).

In response to a request from the Board of Water Commissioners of Holbrook for advice as to the pollution of the water supply of the town by sewage from the Boston School for the Deaf in Randolph, the Department replied as follows on Feb. 7, 1917: —

It appears that the sewage of this school was disposed of for several years into a deep cesspool, from which it filtered away through the ground without objection. Later on a second cesspool was constructed and the overflow was pumped to a field about 250 feet distant where it was disposed of by surface irrigation. This appears to have been found objectionable, and a sub-surface irrigation system was constructed north of the institution that now includes about 1,100 feet of tile drains laid with open joints in trenches constructed and prepared for the purpose. Not long ago a concrete tank and a sub-surface irrigation system were constructed east of the cesspools and nearer North Main Street and also within about 210 feet of one of the brooks which flow into Great Pond.

Under present conditions there is possible danger of the escape of this sewage

into the brook and, in the opinion of the Department, it will be better to discontinue the discharge of sewage at this location and provide for its disposal in sub-surface drains in land farther away from the brook. It appears to be difficult to extend the present system to a suitable place of disposal north of the cesspools on account of the contour of the ground. Under the circumstances, it would probably be better to divert the sewage to the region northwest of the present cesspools, where suitable land appears to be available for its disposal. A sub-surface irrigation system can apparently be constructed without special difficulty northwest of the present pump house and 200 to 300 feet therefrom. Furthermore, it appears to be possible to divert the sewage from the present sewer near the main building and convey it by gravity to the area suggested for its disposal.

In order to properly dispose of the quantity of sewage now discharged from the school, it will be necessary to construct a considerably more extensive tile system than is now available. The extent of this system will depend upon the porosity of the soil, the depth to ground water, etc., but it is likely that additional drains aggregating in length 2,500 to 3,000 feet will be sufficient for the present requirements of the school.

A sewerage system will soon be required in the thickly settled portions of Randolph within the Great Pond watershed if the population in this region continues to grow, and when a sewerage system has been provided the sewage of the school should be removed with that of the other buildings in this region. It is probable, however, that the sewage from the school can be disposed of effectually without serious danger to the water supply for a considerable time in the future if the plan herein suggested is carried out by the school and an adequate sub-surface irrigation system provided in the region indicated.

Randolph (Norfolk County Tuberculosis Hospital).

On July 19, 1917, an application was received from the County Commissioners of Norfolk County for advice as to a plan for sewage disposal at the proposed Norfolk County Tuberculosis Hospital in Randolph, and after a consideration of the plans presented the Department replied as follows on Aug. 9, 1917: —

The plans as submitted provide for disposing of the sewage by intermittent filtration upon a tract of land located about 200 feet east of High Street and 400 feet south of a small brook which enters Blue Hill River in the neighborhood of Randolph Avenue. Two plans are submitted for the disposal of the sewage at this location; — one by collecting the sewage in a reservoir to be located on the institution grounds and pumping it through a main sewer to be laid in Canton and High streets; and the other, by conveying the sewage by gravity from the point of collection near Canton Street, across Canton Street and private land to High Street near the proposed area, and thence to the disposal works.

The plan of removing the sewage to the filter beds by gravity is, in the opinion of the Department, a more desirable one to adopt, under the circumstances.

This plan in general will provide a reasonable and satisfactory method for the disposal of the sewage of this institution without danger of injury to any public water supply, and the Department recommends its adoption with certain modifications which should be included in the plans before the works are constructed.

The receiving and flush tank on the hospital grounds at the head of the gravity sewer and the siphon connected therewith do not appear to be essential to the effective operation of the works, and it is recommended that they be omitted and the sewage, after passing through the basket screen, discharged directly into the main sewer leading to the disposal works.

The cost of the settling tank at the disposal works can probably be reduced somewhat without reducing materially its efficiency by the omission of the two dividing walls, so that, instead of four chambers each 6 feet square, there will be two chambers each 12 feet 8 inches long by 6 feet wide, the dosing chamber being located at the lower end of these two chambers.

It is also desirable, in the opinion of the Department, that the size of the filters be increased somewhat, which can probably be done best by increasing their length from 100 to 120 feet, thus increasing the total filtering area from 10,000 to 12,000 square feet.

The plans include provision for sludge beds, which should be of suitable capacity for the purpose.

With regard to the suggestion made in the application that two filter beds only be built in the beginning, the Department is of the opinion that, in view of the uncertainty existing at the present time as to the probable number of patients likely to be received at this institution in the beginning at least, there is no objection to postponing the construction of two of the filter beds to a later time. The additional filters should be constructed, however, as soon as the quantity of sewage approaches 5,000 gallons per day, in order to prevent danger of raw or imperfectly purified sewage entering the adjacent brook. Measurement of the quantity of sewage flowing to the filter beds can be made in the settling tanks by measuring the time required to fill them.

One of the most important features of the plan is the provision for locating the filters at such an elevation that it will be practicable to refilter the effluent should circumstances make further purification necessary or desirable in the future.

With the modifications herein suggested, the Department is of the opinion that satisfactory provision will be made, so far as can now be forseen, for caring properly for the sewage from this institution.

Southbridge.

In response to a request from the Board of Sewer Commissioners of Southbridge for advice regarding the operation of the sewage filter beds the Department replied as follows on Dec. 10, 1917: —

It appears that the plans under which the present works were constructed for the disposal of the sewage of the town, as approved by this Department in 1907,

provided for the construction of 19 filter beds having an aggregate area of 14.21 acres and 5 sludge beds having an aggregate area of about one acre, with a settling tank for the preliminary treatment of the sewage having a capacity of 240,000 gallons. A portion of the settling tank having a capacity of 135,000 gallons and 11 filter beds with an aggregate area of $8\frac{1}{2}$ acres were put into operation in 1908 and have been used for the disposal of sewage since that time. In the meantime the town has been growing and the sewerage system has been rapidly extended until the number of miles of sewers has risen from about 11 miles in 1908 to about 15.4 miles at the present time, while the number of connections has increased to 1059. The quantity of sewage discharged upon the filters, as measured recently, averages about 900,000 gallons per day with a maximum flow of about 1,700,000 gallons per day. A measurement by the engineers of this Department on June 25–26 last showed that the total quantity flowing at that time was 884,000 gallons per day and that the amount varied from a minimum rate of 543,000 gallons per day to a maximum rate of 1,114,000 gallons.

With the above average quantities of sewage flowing from the sewers, the average rate at which sewage would be applied to the filters, if it were distributed evenly over all the area, is over 100,000 gallons per acre per day, while at times of maximum flow the rate rises to 200,000 gallons per acre per day. The area of sand filters now in use is utterly inadequate to care for and properly purify so large a quantity of sewage as is now applied to them, even though the filters had been constructed and were maintained in the best possible way.

The examinations of the present works show that the settling tank is very efficient in the removal of suspended matters from the sewage, and when emptied at intervals of once a month or less, as has usually been the case recently, the results of sedimentation are satisfactory. The filter beds are not built, however, of the best material, considerable fine material having been used in such a way that the filtering material in the beds is considerably stratified in places, interfering with the efficient action of the filters. An examination of the underdrains shows that their joints are badly clogged, so that very little effluent can enter them, thus tending further to reduce the efficiency of filtration.

The maintenance of the filters has been improved by better care during the past year, and the objectionable conditions due to growths of weeds and other causes have been less serious, but the operation of the filters has been unsatisfactory.

As a result of these investigations, the Department makes the following recommendations: — first, that the area of the filters be enlarged to 14 acres as provided in the original plans; second, that the underdrains in the present filters be relaid or that new underdrains be constructed between the lines of underdrains now in existence and that the filters be reconstructed where necessary to remove fine material and prevent stratification; third, that a caretaker be provided who will give all of his time to the care of the filters and that he be given such assistance as is necessary to put the filters into proper condition each spring and keep their surfaces level and free from weeds or accumulations of organic matter during the summer and fall. Sufficient labor should also be provided to put the beds into proper condition for winter by providing the neces-

sary ridges and furrows. The sewage should be distributed to all of the beds, except those which may be out of use for drying and cleaning, each day, so far as practicable. In general, about three-quarters of the beds should be used each day at all times.

An examination of the records of flow in the main sewer indicates that the minimum rate of flow at night, when very little sewage is being discharged into the sewers, is more than 500,000 gallons per day. A very large part of this flow is undoubtedly caused by leakage into the sewers, a considerable portion of which is no doubt preventable. The Department recommends that a careful inspection be made of the entire sewerage system, that storm water and roof water be excluded therefrom, and that leakage into the sewers be prevented so far as it is found practicable to do so now. If it should be found possible to reduce materially the leakage into the sewers, it would be practicable to dispose of the sewage upon a smaller area of filters than will otherwise be required.

Stockbridge.

On Sept. 26, 1917, the Board of Selectmen of Stockbridge requested approval by the Department of plans for an addition to the sewage disposal area of the town, and after a consideration of the plans submitted made the following reply on Oct. 25, 1917: —

These plans provide for the construction of two additional filter beds with an aggregate area of 0.44 of an acre. These filter beds are to be located on the northeasterly side of the present filter beds and they are to be underdrained with drains laid at a depth of 3.50 to 3.75 feet beneath the surface and 20 feet apart. An examination of the limited amount of sand found at the site of these filters indicates that only a very small quantity is suitable for the purification of sewage, but additional sand can be obtained from a location a little over one-quarter of a mile south of the filter beds west of Church Street on land of George Lovett. By using sand of suitable quality, an abundance of which appears to be available, the proposed new filters, if properly constructed, will add very materially to the capacity of your works for the disposal of sewage. It is still probable that further additions will be necessary, and these additions should be provided as soon as practicable. The extent of the addition necessary can best be determined after the present filters are completed and their capacity has been determined. It is advisable, upon the completion of the new filters, that the filters previously constructed and also the irrigation area be carefully examined to determine whether their capacity cannot be increased by relaying the underdrains and rehandling some of the filtering material. The beds have been kept under excellent care, which has tended to reduce materially the objectionable conditions that might have resulted from the overworking of these filters up to the present time.

The additions and improvements now proposed, when fully completed, should make it practicable to remove any objectionable conditions that have existed about this area in the past, due to the inadequacy of the filters.

Templeton (Massachusetts School for the Feeble-minded).

In response to a request from the Commission on Mental Diseases for advice relative to sewage disposal at the Templeton Colony of the Massachusetts School for the Feeble-minded, the Department, under date of Jan. 20, 1917, replied as follows: —

The sewage of the various colonies is discharged upon crude filter beds of inadequate capacity and considerable quantities overflow upon the ground about these filters. For the present no great harm results from these conditions, though objectionable odors were noticed in the neighborhood of some of these places of sewage disposal. While none of them were so located as to affect the sources of water supply, it would be desirable to provide larger filters at each of these sewer outlets so that all of the sewage may be properly filtered without discharging it upon the ground in the neighborhood of the filters.

Westborough.

In response to a request from the Board of Sewer Commissioners of Westborough for advice relative to improving the efficiency of the sewage filters of the town, the Department replied as follows on July 28, 1917: —

It appears that in the year 1908 there were seven filter beds in use aggregating 4.0 acres and that the number was increased in 1909 to eight beds aggregating 4.5 acres, in 1911 to eleven beds aggregating 5.0 acres, and in 1913 to twelve beds aggregating 5.8 acres. It further appears that the average quantity of sewage discharged at the works each year in the four years from 1913 to 1916, inclusive, ranged from 375,000 gallons per day to 450,000 gallons per day and that the rate of filtration averaged from 65,000 to 80,000 gallons per acre per day. There is, however, a great variation in the flow of sewage at these works, and the flow in the maximum month in the past four years has ranged from 551,000 to 794,000 gallons per day and the rate of filtration during the maximum month from 95,000 to 137,000 gallons per acre per day. During the present year — 1917 — the average flow of sewage to the filter beds in the months of March, April and May has been about 527,000 gallons per day, and the average rate at which the filters have been operated has been 91,000 gallons per acre per day. This quantity of sewage amounts to nearly 1,000 gallons per day per connection with the sewers.

This great flow of sewage to the filters in the winter and spring is due chiefly to the leakage of ground water into the main sewer in the low district through which it is laid. A portion of this infiltration of ground water was excluded some six or seven years ago. The sewage contains considerable manufacturing waste but does not contain an abnormal amount of either organic or suspended matter. It appears, however, that the factory wastes have caused some trouble at the filters and that in one or two cases the filters have been clogged by deposits

due apparently to manufacturing wastes. The sewage is discharged upon the filters without any preliminary treatment and appears to be quite thoroughly distributed, and the filter beds appear to receive reasonable care.

An examination of the analyses of sewage applied to these filters and the effluent therefrom shows that in 1913, after the filters were enlarged, they operated with a high degree of efficiency and produced an effluent of very satisfactory quality. The efficiency decreased during 1914 and 1915 and a further marked decrease took place in the quality of the effluent during the year 1916.

A recent examination of the filtering material in two of the filters indicates that organic matter has penetrated to a considerable depth in these filters and that deposits of iron have taken place in the joints of the underdrains and in the drains themselves. As a result of this examination, the Department is of the opinion that the quantity of sewage discharged upon these filters is much greater than they are capable of receiving continuously and purifying with a reasonable degree of efficiency and, notwithstanding the excellent material of which they are composed and the amount of underdrainage originally provided, the efficiency of the filters is likely to continue to deteriorate and the accumulation of organic matter to increase until the filters become seriously clogged.

In the opinion of the Department, some relief could probably be effected by digging up, cleaning and relaying the underdrains in the beds which operate slowly, or preferably by laying new underdrains halfway between those already in place. If this improvement were made, it is probable that the efficiency of the filters would be increased for a time, but if the quantity of sewage applied to the filters continues to be as great as at present, this improvement would merely postpone the serious deterioration of these works. The best plan of restoring the filters to satisfactory operation will be to reduce materially the quantity of sewage applied thereto by increasing the size of the filtration area. The area of the filters at the present time is 5.8 acres. By adding 1.5 acres the rate of filtration during the months of highest flow in the winter and spring would be reduced to the neighborhood of 70,000 gallons per acre per day, and there is no doubt that, with such an addition to the works and the continued proper operation of the filters as at the present time, their condition would quickly improve and again become satisfactory.

It is possible that the present excessive load on the filters can be materially relieved by reducing the amount of leakage into the sewers. The leakage into the main sewer of the town of Westborough was formerly very large, but a material reduction of this leakage has been made by your board by reconstructing a portion of the main sewer. It is probable that a further material reduction could be made by relaying the additional portions of this sewer in which the greatest amount of leakage is found and by the prevention of leakage into other portions of the system where the quantity may be found to be excessive.

If the leakage into the sewers can be reduced by from 100,000 to 150,000 gallons per day, it is probable that, with an improvement in the underdrainage system, the condition of the present filters would improve and that they would thereafter care properly for all of the sewage, though they would require enlargement from time to time to provide for the growth of the town.

The Department will be pleased to give you such assistance as it can in making further investigations as to the enlargement of the filters or the reduction in the amount of leakage into the sewerage system and will give you further advice in this matter when the results of further investigations are available.

Westfield (State Sanatorium).

On Jan. 31, 1917, the Department received from the superintendent of the Westfield State Sanatorium a plan providing for the construction of new sewage filters for that institution about 300 feet west of the filters then in use, and on Feb. 7, 1917, the Department gave the following advice: —

The soil at this site is not suitable for sewage purification, but excellent material for this purpose is found in an adjacent knoll north of the existing filters, and it is proposed to use that material in the construction of the works. The plans provide for the construction of 8 filters having an aggregate area of 1.03 acres and a depth of about 4 feet, all of the filters to be thoroughly underdrained into the adjacent brook.

The Department has considered the plans presented and is of the opinion that they will provide adequately for the disposal of all of the sewage of the institution, while its population is no greater than at the present time, without causing objectionable conditions in the neighborhood. It is important that the plans be followed out carefully in the construction of works and that trees shall be planted about them as proposed in the plan presented. When the proposed filters are completed, the filters now in use should be abandoned, since their condition has become such that they are not likely to be of further material value in the disposal of the sewage.

The Department urges that this work be undertaken at the earliest practicable time, since odors from the present filter beds are noticeable at times at the hospital buildings, a very objectionable condition under the circumstances.

Winchendon.

On Jan. 19, 1917, the Department received from the Board of Sewer Commissioners of Winchendon an application for the approval of a system of sewage disposal for the town, with plans showing the following schemes for the disposal of the sewage: —

Scheme 1.

Temporary Outlet for the Partially Treated Sewage into the Millers River.

Build the screen chamber, settling tanks and a part of the sludge beds. Discharge the effluent from the settling tank through the westerly distributing pipe into the main sub-drain and through this sub-drain into the channel of the Millers

River, at a point about 200 feet above the highway bridge, the outlet to be below the surface of the water in the river. This is the scheme approved by your Board May 21, 1913, in which permission is given to discharge the partially treated sewage into the Millers River until July 1, 1918. Providing this method is approved by your Board, the Commissioners would request an extension of the period during which sewage may be disposed of by this method. On the expiration of the period allowed for disposing of the sewage by the method indicated in Scheme 1, the dosing tank and filter beds to be built as indicated in Scheme 3 and the sewage to be treated as therein outlined.

Scheme 2.

Build the screen chamber, dosing tank and a part of the filter beds. Discharge the screened sewage directly onto the filter beds. This scheme contemplates the permanent treatment of the sewage by discharging crude sewage directly onto the filter beds without any previous treatment except screening to remove the larger solid matters which may be delivered at the filtration area.

The outlet of the underdrains will be at the same point as indicated in Scheme 1. If this scheme is adopted the screen chamber and dosing tank will be so located as to make it possible to build the settling tank at any time in the future. Sludge beds "A" to "I" may be used as filter beds, providing the sewage is not settled, and can be used as sludge beds if the settling tanks should be built at any future period.

Scheme 3.

Build the screen chamber, settling and dosing tanks and a part of the filter and sludge beds. The settling tanks are designed so that sludge can be removed from the bottom of the tanks without emptying the entire tank. It will thus be possible to remove the sludge from the bottom of the tank at such frequent intervals as to prevent any great decomposition of the sludge. This sludge will be delivered onto the sludge beds.

Scheme 3 may be modified as follows:

(*a*) Build two sludge digestion tanks easterly of and adjacent to the settling tank. Discharge the sludge from the settling tank into the sludge digestion tanks and from these tanks onto the sludge beds.

(*b*) Build an Imhoff Tank in place of the settling tanks.

After a consideration of the plans the Department sent the following reply on Feb. 27, 1917: —

The nuisances at present caused by sewage in the thickly settled portions of the town of Winchendon are most serious and, in the opinion of the Department, it is of the greatest importance, for the protection of the public health, that a sewerage system shall be provided at the earliest practicable time. The town is growing rapidly, however, and a comparison of the flow of the Millers River with the quantity of sewage that will be discharged from the town after a sewerage system has come into general use shows very clearly that a nuisance would

be created if the sewage were discharged into the river without adequate treatment.

Considering the circumstances, the Department approves the general plan of treating the sewage of the town of Winchendon upon 14 acres of filter beds situated near the Millers River southwest of the town, as indicated upon the plan submitted, and recommends the adoption of Scheme No. 3 presented in your application, which provides for building in the beginning a screen chamber, settling and dosing tanks and part of the filter and sludge beds.

The Department further recommends that the plans before the Board be modified so as to show the portion of the works to be constructed under Scheme No. 3, and, as soon as you have decided upon the area in which you propose to construct sewers in the beginning, the Department will be pleased to confer with your engineer as to the portion of the disposal works which shall be constructed at the same time in order to provide for the adequate purification of the sewage.

MISCELLANEOUS.

Boston.

Under date of Jan. 16, 1917, the Department sent the following communication to the Board of Commissioners on Fisheries and Game relative to prohibiting the taking of shellfish from the waters of Boston Harbor: —

The State Department of Health, acting under the provisions of section 113 of Chapter 91 of the Revised Laws of Massachusetts, requests your Honorable Board to prohibit the taking of any oysters, clams or quahaugs from the waters or flats of Boston harbor, including the tributaries of the Charles, Mystic and Neponset rivers, the Chelsea River and Dorchester and Quincy bays, inside, or west, of a line drawn from Nut Island to Prince's Head; thence along the bar from Prince's Head to Peddocks Island and through Peddocks Island to the northeasterly end thereof; thence to the southeasterly point of Deer Island and through Deer Island and across Shirley Gut to Point Shirley, excepting along the Winthrop shore inside, or northeast, of a line drawn from the outer end of the steamboat landing of the Point Shirley Club at Point Shirley to the outer end of the Cottage Park Yacht Club wharf on the southerly shore of Winthrop between Orlando and Woodside avenues; and to prohibit also the taking of any such shellfish about the shores of Lovells, Gallups and Georges islands for a period of three years from and after the date hereof.

Fall River.

On Jan. 17, 1917, the Department received from the Quequechan River Commission of Fall River an application requesting consideration of certain preliminary plans for the improvement of the Quequechan River under the provisions of chapter 311 of the Special Acts of

the year 1916, the important sections of the application being as follows: —

Enclosed herewith is copy of brief preliminary report and set of plans on the Quequechan River Improvement at Fall River.

As noted therein, I am submitting these to you at the direction of the Quequechan River Commission for consideration of the general features of the plans prior to going into further details, in order that we may be sure that we are proceeding along general lines that will meet with your approval before holding any hearings at Fall River in regard to the matter. . . .

. . . The Quequechan River Commission requests that, if possible, early consideration be given these plans, in order that they may proceed with necessary hearings and any revisions required prior to submission to the City Council of Fall River, which must be on or before April 1, 1917.

The essential features of the report and plans describing the proposed scheme for the improvement of the river are as follows: —

(1) The deepening of the present basin of the Quequechan River between the Sand Bar at the outlet of South Watuppa Pond and the Watuppa Dam, so that the water shall not be less than 5 feet in depth at all times, except possibly in the winter months, and may in some places reach a maximum depth of 6.5 feet.

(2) The construction of a dam at the Sand Bar at the outlet of South Watuppa Pond and the erection at that point of a pumping station and appurtenances with pumps having a combined capacity of 80 million gallons per day when operating against a head of 4 feet.

(3) The filling of certain portions of the flats about the present basin, amounting in area to about 42 acres, located chiefly at the head of long bays, with material dredged from the bottom of the basin.

(4) The construction of a large conduit, to be used also as an outfall sewer, from Plymouth Avenue at the crossing of the Quequechan River down to tide water in the Taunton River.

(5) The construction of two sanitary sewers bordering the basin above Quequechan Street and a main sewer along the easterly side of the basin from Quequechan Street to the upper end of the proposed outfall sewer to remove the sewage to an outlet into the Taunton River.

(6) The installation of surface drains, utilizing existing surface drains, or in some cases existing sewers to be converted into surface drains, to collect the surface drainage of the area tributary to the proposed basin and discharge it into the basin; the plans providing that all surface drainage shall enter the basin and all sewage shall be discharged into the outfall conduit leading to the Taunton River.

Under date of Feb. 27, 1917, the Department replied to the Quequechan River Commission as follows: —

The plans provide for drawing down South Watuppa Pond to such level as may be necessary to secure approximately its full dry season capacity, making available a minimum yield of 20 million gallons per day.

The elevation of South Watuppa Pond at high water is 129.42, and the elevation of the water in the proposed basin is to be maintained at from 128 to 129, so that whenever the water level in the South Pond falls below 128 it will be necessary to pump water from the pond into the basin. It is stated, furthermore, that during some of the winter months the pumping of water from the South Pond into the basin might be deferred until the water level in the South Pond and in the basin falls to about level 127. The present elevation of the bed of the proposed basin varies from 124 to 125, and in order that the depth of water shall not be less than 5 feet at all points when the elevation of the water is at level 128, it will be necessary to dredge the basin in general to about elevation 123.

The report states that the material to be dredged consists largely of mud or other soft material which it is proposed to place on certain areas adjacent to the shores, confining it by means of filled embankments of gravel or quarry wastes. Most of the areas to be thus filled are located on the easterly side of the river, and the embankment required for holding the fill is to be utilized for the location of the principal main sewers on that side of the basin to be constructed as a part of the improvement. The shores of the proposed basin where they consist of firm gravel will receive little or no treatment, while in other places where filled embankments are to be made the shores are to be riprapped, and in a few places masonry walls are to be constructed to hold back the fill. There are several areas back of the present embankments which are now being filled with cinders or other filling by the mills, and these are to be left for the continuance of this practice. The bottom of the proposed basin will consist largely of mud.

The mills along the basin which use the water for condensing would under this plan continue to use it in most cases from their present intakes, but where fills are to be made, from intakes extended beyond the fills. These intakes, consequently, will remain practically in the same general locations as at the present time. A certain quantity of water to be used for power below the Watuppa Dam would continue to flow down the channel of the stream.

The total cost of the proposed works, as estimated in the report presented, is $768,000.

The Department has carefully examined the report and plans submitted therewith and has considered the advantages and probable effect of the proposed scheme in abating the nuisances in and along the Quequechan River and in preventing further objectionable pollution thereof.

The subject of the improvement of the Quequechan River has been under consideration by the city for a number of years, and there appear to be no differences of opinion as to the seriousness of the nuisances now existing there during the warmer portion of the year or the great need of abating this nuisance at the earliest practicable time.

At the present time the basin of the Quequechan River between the South Pond and the Watuppa Dam has an area of about 182 acres at high water,

which is elevation 129.42, and a storage capacity below that elevation which has been variously estimated at from 280 to 325 million gallons. During the drier part of some of the recent dry years, however, the water level of the Quequechan River above the Watuppa Dam, which reaches its maximum height usually in the late spring, has been gradually drawn down to as low as 3 feet and possibly lower in the autumn, leaving in storage in the basin a quantity of water amounting probably to from 90 to about 120 million gallons.

If works should be constructed in accordance with the plans now before the Department, there would be created on the Quequechan River between the Sand Bar at the outlet of South Watuppa Pond and the Watuppa Dam a basin smaller in area and of about the same capacity as that now existing there but slightly deeper and maintained at a more constant level. Under the new conditions proposed by the plan now under consideration, the basin would have an area of 140 acres at high water and a storage capacity below that level about equal to the maximum storage under present conditions.

The mills which now draw water from the basin are located along its shores, but chiefly toward the lower end where the basin is narrow and the intakes and discharges of the mills are in some cases but short distances apart. Observations of the quantity and temperature of the water discharged from the mills indicate that, with the quantity of water used for cooling at the present time, there is no doubt that the temperature of the water of the basin will be raised materially in warm weather, and in periods of continued hot weather the indications are that it will reach 90° at times, while toward the lower end, where the basin is narrow and the intakes and discharge pipes are situated more closely together than elsewhere, the water will become even warmer.

Under the proposed conditions there seems to be little doubt that the temperature of the water in parts of the basin at least, and probably in all of it at times, will be raised to a higher level than is desirable in water used for condensing purposes with a resultant loss of efficiency in the operation of the power plants at the mills.

Furthermore, judging from the information contained in the reports of the various investigations of the Quequechan River, it seems evident that there has been a considerable increase in the use of water for condensing in recent years, and it is of course obvious that, if the city is to continue to grow, there will be a continued increase in the quantity of water required for this purpose, unless some other form of power is substituted for that now in use. It is probable, therefore, that at no distant time the quantity of water used for condensing will be as great in proportion to the capacity of the proposed basin as it is in proportion to the quantity of water contained in the basin as it exists at the present time in periods when the water is low.

The character of the water that will be introduced into the proposed basin from the South Pond would be very satisfactory for manufacturing uses, but the basin would receive, in addition to the water from the South Pond, some 30 million gallons per day of water used in condensing and would also receive at times of heavy rain all of the flow of surface water from about two square miles of drainage area naturally tributary to the basin. In an ordinary rain storm

with an inch of precipitation, assuming that one-half of it reached the basin, the basin would receive about 18 million gallons of water, which would represent the washings of streets and yards in a part of the city already thickly populated and which will in time become densely so. These street washings would carry large quantities of putrescible organic matter into the basin. Moreover, the basin will be shallow, averaging about 5 feet in depth under ordinary conditions over most of its area, with sloping banks in places where the water will of course be shallow. Such conditions would undoubtedly be very favorable for the growth of organisms in the warmer part of the year, especially of the kinds which grow in suspension in the water, and doubtless also of the larger organisms attached to the bottom and sides of the basin. Experience with similar basins in other places where the temperature of the water is not artificially raised, as would be the case here, has shown that large growths of organisms take place under such circumstances which render the water turbid and often disagreeable in smell. The experience with the present basin, with its excessive growths of organisms during the warmer part of the year, indicates how favorable such conditions are for the growth of organisms under such circumstances.

The information presented to the Department indicates that the water of the present basin is unsatisfactory for some manufacturing uses, and water for manufacturing purposes is taken from the city water supply. It is important that the water of the river shall be kept in such condition that when delivered to the mills it will be as satisfactory for manufacturing and mechanical uses, if possible, as that from the city mains and thus avoid increasing unnecessarily the diversion of water from the city water supply.

Under the circumstances, it appears to the Department essential that provision be made for removing the greater part at least of the storm water to a point of discharge below the basin, though it is not probably necessary that provision be made for the removal of all the water in maximum storms, since the water falling in the latter part of great rains would probably not cause serious objection if a portion were permitted to discharge into the basin, thus avoiding the construction of channels of excessive size for the complete removal of storm water.

It also appears to the Department important to provide a greater amount of cooling water and to insure that clean, cool water be made available to all of the mills, both for cooling and for manufacturing purposes. Modifications in your proposed plans sufficient to provide for these changes will undoubtedly make necessary a material increase in the cost of the work but, unless these changes are made, the results are likely, in the opinion of the Department, to be very unsatisfactory and to lead to conditions which will require a further improvement in the not distant future.

Furthermore, it seems to the Department not improbable that the actual cost of the works will be materially greater than shown in the preliminary estimate presented, and it appears desirable, in conclusion, to compare the present plan with the one previously presented by the city for the consideration of this Department, to see how the advantages of that plan compare with the present.

(1) The former plan provided for supplying clean, cool water from the South Pond to every mill along the stream, while in the case of the present plan the

water supplied will be much higher in temperature, and at the lower mills, even in the beginning, may be nearly, if not quite, as high as that now supplied there.

(2) The warm water, instead of being discharged into the basin to raise the temperature of the water at the intakes, was in the former plan to be returned to the South Pond, where it would be cooled and made available for further use.

(3) The former plan provided for the removal of all of the oil which could be removed from the water in a basin provided for the purpose at the South Pond, whereas under the present plan the oil will continue to discharge into the basin and create objectionable conditions there, since no provision appears to have been made for its removal.

(4) The former plan provided for the removal of all surface drainage from the area tributary to the Quequechan River, whereas the present plan admits all such drainage to the basin, which would inevitably cause the serious pollution of the water.

(5) By the former plan the basin was to be filled and all of the water carried in conduits so that the present nuisance would surely be abated. Under the present plan the basin is likely to become objectionable at no distant time after the works are established.

(6) The former plan provided for the reclamation of 146 acres of land in the central part of the manufacturing district of the city which would be available for the extension of the mills and the construction of new works. The plans now presented provide for reclaiming only about 42 acres of the present basin.

(7) The estimates of cost of works proposed in the former plan were much greater than the estimates for the present plan, but in the case of the former plan certain advantages were secured which do not appear to be provided for in the present plan as follows: — (*a*) under the former plan the water would be drawn from the South Pond and delivered to the mills above and below the Watuppa Dam by gravity, while under the present plans the water will have to be pumped except at such times as the South Pond is nearly at the level of full pond; (*b*) under the former plan the bridges at Quequechan Street and Plymouth Avenue were eliminated, but under the present plan it will still be necessary to maintain bridges at each of these streets, the cost of which should be included in the present scheme; (*c*) by the former plan no open basin was required, but by the present plan there will still be an extensive basin which will require considerable care, and the cost of its maintenance should be provided for in the estimates; (*d*) the former plan provided for an ample supply of clean water, for condensing, mechanical and manufacturing uses, but the present plan would not probably provide water sufficiently clean for all purposes, and water would still have to be taken from the city supply for certain purposes in the mills, or else filters would have to be installed for the treatment of the water taken from the basin, allowance for which should be made in the estimates of cost.

The Department, having considered the plans and information presented, is of the opinion that, while the proposed plans would probably improve the conditions for a time after the works were built, the basin would still remain objectionable and the condition of the water would remain unsatisfactory for use in the mills. The works are likely to cost a larger sum in the beginning than is

indicated by the estimates, and a further large outlay for improvement would probably be necessary at some future time.

Under the circumstances, the Department does not recommend the adoption of these plans.

Norwood (George H. Morrill Company).

In response to a request from the George H. Morrill Company of Norwood for advice as to the disposal of sewage and manufacturing wastes from their new dye manufacturing building, the Department replied as follows on Jan. 20, 1917: —

It appears from the information presented that the wastes from this building will consist in part of highly-colored wash water which, however, will be free from suspended matter, and also waste water containing about 5 per cent. of sulphuric acid. The soil in the vicinity of the building is extremely coarse and porous, and the plan provides for disposing of the highly-colored wash water upon a filter to be located about 70 feet from the Neponset River and at a considerably higher elevation. The area of this filter as proposed in the beginning is approximately 2,500 square feet, but the conditions are such that it can readily be enlarged in case of need.

For the disposal of the acid waste, it is proposed to provide a cesspool located at a point about 270 feet from the Neponset River, this cesspool to be 14 feet in diameter at the top and 10 feet at the bottom, with an effective depth of 5 feet. Considering the character of the soil in this region, it is probable that, unless the quantity of acid is excessive, it will pass off through the ground without having an objectionable effect upon the river.

The estimated number of operatives to be employed at the new building is 12, and for the disposal of the sewage from sinks and closets it is proposed to provide a cesspool located about 90 feet from the Neponset River having an effective depth of about 3 feet. Under the circumstances, it is probable that the cesspool will provide satisfactorily for the disposal of the sewage, but if difficulty is experienced additional cesspools can be provided in the future as may become necessary.

The plan as a whole appears to the Department to make a reasonable provision for the disposal of these wastes in such a way that they will be unlikely to create a nuisance in or pollute the Neponset River, and the Department recommends the adoption of the plans proposed for the disposal of the sewage and wastes from this works.

Woburn (Algonquin Leather Company).

In response to a request from the Algonquin Leather Company for advice as to a method of disposing of the wastes from their tannery in North Woburn, the Department, under date of July 3, 1917, made the following reply: —

The results of tests of the trickling filters show that they have little or no effect in purifying the wastes applied to them. These filters were not constructed in accordance with the plans submitted for the consideration of this Department in 1912, which called for filtering material of coke or gravel, but were constructed to a considerable extent with large stone, and the distribution of the wastes on the filters is poor.

Test pits dug in the low ground to the east of the factory northeast of the trickling filters show that beneath the surface soil and a subsoil ranging from 1 to 2 feet in depth there is a deep layer of sand which, while somewhat fine, would undoubtedly purify the waste from your tannery, if filters suitably underdrained were constructed of this material and operated at a rate no greater than about 30,000 gallons per acre per day.

Judging from a superficial examination, it appears probable that there is sufficient area of land containing this sandy soil to allow for the construction of filters of adequate area for the purification of all the wastes from the tannery. An examination of the soil in a gravelly knoll southwest of the trickling filters shows that it consists of much coarser material than the low sandy land to the northeast of the trickling filters, and if filters were constructed of this coarser material, a smaller area would be adequate for the purpose than if the finer sand in the lower ground should be used.

It is not practicable to advise you whether the construction of the sand filters of natural soil northeast of the trickling filters would be the more desirable or whether it would be more economical to construct the filters wholly of the coarser material from the gravelly knolls without more definite information than is now available to the Department.

In view of the circumstances, the Department recommends that you have plans prepared as soon as practicable of both methods by an engineer of experience in matters relating to the disposal of sewage and manufacturing waste, and when the plans are available the Department will, upon request, advise you as to which method is the more desirable to adopt under the existing circumstances.

Division of Food and Drugs.

DIVISION OF FOOD AND DRUGS.

List of Prosecutions for Violations of the Food and Drug Laws.

For Sale of Milk containing Added Water.

Name.	Address.	Court.	Date.	Result.
Adams, John,	Natick,	Natick,	Sept. 5, 1917	Conviction.
Algeo, Joseph B.,	Concord,	Concord,	May 11, 1917	Conviction.
Algeo, Joseph B.,	Concord,	Concord,	May 11, 1917	Conviction.
Arruda, Jesse,	Dartmouth,	New Bedford,	Nov. 5, 1917	Conviction.
Bennett, Matthew J.,	Woburn,	Woburn,	Oct. 5, 1917	Conviction.
Bowen, Everett A.,	Lakeville,	Middleborough,	Aug. 28, 1917	Conviction.[1]
Boyd, Frank,	Essex,	Gloucester,	Oct. 8, 1917	Conviction.
Boyd, Frank,	Essex,	Gloucester,	Oct. 8, 1917	Conviction.
Burgess, Jos. F.,	Foxborough,	Walpole,	Aug. 29, 1917	Conviction.
Corman, James,	Freetown,	New Bedford,	July 13, 1917	Conviction.
Cousins, Geo. L.,	Lincoln,	Concord,	May 29, 1917	Conviction.
Damon, Isaac,	Wayland,	Framingham,	July 19, 1917	Conviction.[1]
DeCosta, Antonio H.,	Braintree,	Quincy,	May 12, 1917	Conviction.
DeMello, M. I.,	New Bedford,	New Bedford,	Sept. 17, 1917	Conviction.
Doty, Ernest F.,	Beverly,	Salem,	Aug. 10, 1917	Conviction.
Enos, Antone,	Acushnet,	New Bedford,	Jan. 15, 1917	Conviction.
Fuller, Frederick H.,	Foxborough,	Walpole,	Oct. 19, 1917	Conviction.
Griggs, John,	Holliston,	Framingham,	July 26, 1917	Conviction.
Grout, Francis W.,	Ashburnham,	Fitchburg,	May 29, 1917	Conviction.[1]
Hawes, Eugene R.,	Foxborough,	Walpole,	Aug. 29, 1917	Conviction.
Hebert, Benj.,	Acushnet,	New Bedford,	July 13, 1917	Conviction.
Houghton, Everett L.,	Cochituate,	Framingham,	July 26, 1917	Conviction.
Kaufman, Abraham,	Attleboro,	Attleboro,	Dec. 4, 1916	Discharged.
Kaufman, S. C.,	Attleboro,	Attleboro,	Dec. 15, 1916	Conviction.[1]
Keenan, John W.,	Waltham,	Waltham,	Feb. 19, 1917	Conviction.[1]
Laurie, John A.,	Lexington,	Concord,	July 9, 1917	Conviction.[1]
Machado, John,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Martin, Antone,	New Bedford,	New Bedford,	Nov. 12, 1917	Conviction.

[1] Appealed.

For Sale of Milk containing Added Water — Concluded.

Name.	Address.	Court.	Date.	Result.
McAdams, John F.,	Chelsea,	Chelsea,	Dec. 29, 1916	Conviction.
McEnaney, Thos.,	Arlington,	Cambridge,	Apr. 27, 1917	Conviction.
Mendelson, Benj.,	Malden,	Malden,	May 15, 1917	Conviction.
Nowak, Michael,	Oxford,	Webster,	Oct. 9, 1917	Conviction.
Penney, Henry J.,	Saugus,	Malden,	Mar. 27, 1917	Conviction.
Perry, Frank E.,	New Bedford,	New Bedford,	Sept. 17, 1917	Conviction.
Perry, Manuel,	New Bedford,	New Bedford,	Sept. 17, 1917	Conviction.
Perry, Manuel and Frank,	New Bedford,	New Bedford,	Nov. 12, 1917	Conviction.
Perry, Michael,	Attleboro,	Attleboro,	Dec. 15, 1916	Conviction.
Rice, Robert A.,	Pittsfield,	Pittsfield,	Oct. 31, 1917	Conviction.
Rivera, John,	Dartmouth,	New Bedford,	July 13, 1917	Conviction.
Roberts, Louis E.,	Lexington,	Concord,	Aug. 24, 1917	Conviction.
Robertson, Artemas,	Harwich,	Harwich,	Sept. 21, 1917	Conviction.
Robson, Adam,	Salem,	Salem,	Aug. 17, 1917	Conviction.
Robson, Adam,	Salem,	Salem,	Oct. 27, 1917	Conviction.
Schaffner, George H.,	Watertown,	Newton,	June 8, 1917	Conviction.[1]
Silvia, Frank,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Silvia, John B.,	Dartmouth,	New Bedford,	Sept. 17, 1917	Conviction.
Smith, George W.,	Tyngsborough,	Lowell,	June 1, 1917	Conviction.
Stadelman, Augustus,	Marlborough,	Marlborough,	Mar. 31, 1917	Conviction.
Sykes, Louis,	Norwood,	Dedham,	Sept. 5, 1917	Conviction.[1]
Weeks, Harry W.,	Framingham,	Framingham,	July 19, 1917	Conviction.
Willard, Emery C.,	Ashby,	Fitchburg,	Apr. 25, 1917	Conviction.
Wilson, Charles A.,	Medway,	Franklin,	July 14, 1917	Conviction.
Woodward, Frank W.,	Northampton,	Northampton,	Sept. 12, 1917	Conviction.

For Sale of Milk not of Good Standard Quality.

Farmers Milk Company,	Cambridge,	Cambridge,	May 10, 1917	Discharged.
Gardes, Peter,	Brockton,	Brockton,	Nov. 20, 1917	Conviction.
Graustein, Wm. A.,	Cambridge,	Cambridge,	Mar. 29, 1917	Discharged.
Smith, Emma,	Salem,	Salem,	Aug. 17, 1917	Conviction.
Stadelman, Augustus,	Marlborough,	Marlborough,	Mar. 31, 1917	Conviction.

[1] Appealed.

For Sale of Milk from which a Portion of the Fat had been removed.

Name.	Address.	Court.	Date.	Result.
Acton Farms Milk Company,	Somerville,	Cambridge,	May 17, 1917	Conviction.[1]
Becrelis, Nicholas,	Framingham,	Framingham,	Oct. 1, 1917	Conviction.[1]
Becrelis, Nicholas,	Framingham,	Framingham,	Oct. 1, 1917	Conviction.
Berger, Solomon,	Cambridge,	Cambridge,	Oct. 17, 1917	Discharged.
Brennan, Frank S.,	Salem,	Salem,	Nov. 30, 1917	Discharged.
Brennan, Frank S.,	Salem,	Salem,	Nov. 30, 1917	Discharged.
Charpentier, Edward,	New Bedford,	New Bedford,	Sept. 17, 1917	Conviction.
Direne, Philip,	Salem,	Salem,	Nov. 9, 1917	Conviction.
Dutra, Jesse A.,	Barnstable,	Barnstable,	Sept. 27, 1917	Conviction.
Eaton, B. F.,	Barnstable,	Barnstable,	Sept. 27, 1917	Conviction.
Evans, Harry,	Revere,	Chelsea,	July 23, 1917	Conviction.[1]
Fitch, Harry V.,	Salem,	Salem,	Nov. 30, 1917	Discharged.
Fitch, Harry V.,	Salem,	Salem,	Nov. 30, 1917	Discharged.
Fuller, Frederick H.,	Foxborough,	Walpole,	Oct. 19, 1917	Conviction.[1]
Gontarz, Frank,	Ipswich,	Ipswich,	Nov. 13, 1917	Conviction.
Gordan, James,	Nahant,	Lynn,	Aug. 13, 1917	Conviction.
Haggis, James,	New Bedford,	New Bedford,	Sept. 17, 1917	Conviction.
Kaufman, S. C.,	Attleboro,	Attleboro,	Dec. 15, 1916	Conviction.[1]
Kaufman, S. C.,	Attleboro,	Attleboro,	Dec. 15, 1916	Conviction.
Kaufman, S. C.,	Attleboro,	Attleboro,	Dec. 15, 1916	Discharged.
Kenney, Nathan,	Pittsfield,	Pittsfield,	July 10, 1917	Conviction.
Klonkinio, George,	Nantasket,	Hingham,	July 9, 1917	Conviction.
Leatherbee, F. K.,	Barnstable,	Barnstable,	Sept. 27, 1917	Dismissed.
London, Samuel,	Saugus,	Malden,	June 12, 1917	Conviction.[1]
Medeiros, Joseph,	Shawmut,	New Bedford,	July 13, 1917	Conviction.
Robson, Adam,	Salem,	Salem,	Aug. 17, 1917	Conviction.
Robson, Adam,	Salem,	Salem,	Aug. 17, 1917	Conviction.
Suzan, Manuel,	Barnstable,	Barnstable,	Sept. 27, 1917	Conviction.
Venturi, Adolph,	Plymouth,	Plymouth,	July 27, 1917	Conviction.
Waitt, Marie,	Nahant,	Lynn,	Aug. 13, 1917	Conviction.
Woodbury, George O.,	Barnstable,	Barnstable,	Sept. 27, 1917	Conviction.[1]
Zimera, Frank,	Pittsfield,	Pittsfield,	July 3, 1917	Conviction.

[1] Appealed.

For Sale of Ice Cream below Standard.

Name.	Address.	Court.	Date.	Result.
Davis Ice Cream Company,	Cambridge,	East Boston,	Nov. 15, 1917	Conviction.
Davis Ice Cream Company,	Cambridge,	East Boston,	Nov. 15, 1917	Conviction.
The Meyers Store, Inc.,	Pittsfield,	Pittsfield,	Aug. 3, 1917	Conviction.

For Sale of Adulterated Foods Other than Milk and Milk Products.

BUTTER.

[Renovated; not properly marked.]

Pappazian, Percy,	Brockton,	Brockton,	Feb. 28, 1917	Conviction.

CIDER.

[Contained salicylic acid.]

Godin, L. Henry,	Weymouth,	Quincy,	Dec. 14, 1916	Conviction.

CIDER VINEGAR.

[Not the product of pure apple juice.]

Sherman, Edward J.,	Springfield,	Springfield,	June 12, 1917	Conviction.

COCOA.

[Contained sugar; not properly labeled.]

Walker, James R.,	Lawrence,	Lawrence,	Mar. 23, 1917	Dismissed.

CONFECTIONERY.

Chocolate Almond Bar.

[Wormy and contained no almonds.]

The Wason Company,	Boston,	Waltham,	Dec. 20, 1916	Conviction.

EGGS.

[Not strictly fresh; sold as strictly fresh.]

Brooks, Albert F.,	Brockton,	Brockton,	Mar. 14, 1917	Conviction.
Brooks, Albert F.,	Brockton,	Brockton,	Mar. 14, 1917	Conviction.
Co-operative Grocery Stores Company.	Wellesley,	Dedham,	June 17, 1917	Conviction.
Mellor, George,	Brockton,	Brockton,	Mar. 14, 1917	Conviction.[1]

[1] Appealed.

For Sale of Adulterated Foods Other than Milk and Milk Products — Continued.

EGGS — *Concluded.*

[Not strictly fresh; sold as strictly fresh.]

Name.	Address.	Court.	Date.	Result.
Mellor, George,	Brockton,	Brockton,	Mar. 14, 1917	Conviction.[1]
Mills Tea and Butter Company.	Stoughton,	Stoughton,	Feb. 9, 1917	Discharged.
Mills Tea and Butter Company.	Stoughton,	Stoughton,	Feb. 9, 1917	Discharged.
Ossolinski, Lucas,	Salem,	Salem,	Jan. 12, 1917	Conviction.
Perroni, John,	Salem,	Salem,	Jan. 12, 1917	Conviction.
The Great Atlantic and Pacific Tea Company.	Stoughton,	Stoughton,	Feb. 27, 1917	Discharged.
The Great Atlantic and Pacific Tea Company.	Brockton,	Brockton,	Mar. 28, 1917	Conviction.[1]
Winer, Jacob,	Salem,	Salem,	Jan. 12, 1917	Conviction.

HAMBURG STEAK.

[Contained a compound of sulphurous acid.]

Burg, Morris,	Quincy,	Quincy,	Dec. 14, 1916	Conviction.
Cohan, Louis,	Boston,	Boston,	Jan. 31, 1917	Conviction.[1]
Drouin, Paul,	Danvers,	Salem,	Mar. 23, 1917	Conviction.
Epstein, Harry,	Dorchester,	Dorchester,	Apr. 13, 1917	Conviction.
Fyfe, Robert J. M.,	Boston,	Boston,	Feb. 6, 1917	Conviction.
Ginsburg, Jacob,	Boston,	Boston,	Feb. 2, 1917	Conviction.[1]
Kamensky, Samuel,	Charlestown,	Charlestown,	Mar. 6, 1917	Conviction.
Krancewick, Charles,	Stoughton,	Stoughton,	Dec. 28, 1916	Conviction.
Marcus, Meyer L.,	Dorchester,	Dorchester,	Jan. 31, 1917	Conviction.[1]
Racoff, Benj.,	Waltham,	Waltham,	Feb. 1, 1917	Conviction.
Sandler, Louis,	Boston,	Boston,	Feb. 2, 1917	Discharged.
Shakelford, Frederick W.,	Gloucester,	Gloucester,	Apr. 6, 1917	Conviction.
Yauss, William,	Stoughton,	Stoughton,	Dec. 28, 1916	Conviction.

LARD.

[Compound; not so labeled.]

Jegelewicz, Simon,	Westfield,	Westfield,	July 11, 1917	Conviction.
Keefe, Raymond,	Lawrence,	Lawrence,	Sept. 10, 1917	Conviction.
O'Boy, Anthony,	Brockton,	Brockton,	Nov. 20, 1917	Conviction.

[1] Appealed.

For Sale of Adulterated Foods Other than Milk and Milk Products — Continued.

Maple Sugar.

[Contained cane sugar.]

Name.	Address.	Court.	Date.	Result.
Dondero, Ralph,	Dorchester,	Dorchester,	Apr. 30, 1917	Conviction.[1]
Karchenes, Efthenios,	Roxbury,	Roxbury,	Apr. 24, 1917	Discharged.

Olive Oil.

[Contained cottonseed oil.]

Name.	Address.	Court.	Date.	Result.
Spiropoulos, Constantino,	Boston,	Boston,	Dec. 20, 1916	Conviction.
Spiropoulos, Constantino,	Boston,	Boston,	Dec. 20, 1916	Conviction.
Yochelman, Isador,	Chelsea,	Chelsea,	Dec. 2, 1916	Conviction.[1]

Peas (Canned).

[Dried peas soaked before canning.]

Name.	Address.	Court.	Date.	Result.
The Great Atlantic and Pacific Tea Company.	Boston,	Roxbury,	June 13, 1917	Discharged.
The Great Atlantic and Pacific Tea Company.	Boston,	Roxbury,	June 13, 1917	Discharged.

Sausage.

[Contained cereal or vegetable flour in excess of 2 per cent.]

Name.	Address.	Court.	Date.	Result.
Borowik, Michael,	Fall River,	Fall River,	Feb. 8, 1917	Conviction.
Gelt, Samuel,	Lawrence,	Lawrence,	Apr. 13, 1917	Conviction.
Kuechler, Kurt,	New Bedford,	New Bedford,	Feb. 5, 1917	Discharged.
Lawrence, Robert,	Fitchburg,	Fitchburg,	Apr. 18, 1917	Discharged.
Luzio, Gaudenza,	Dorchester,	Dorchester,	Feb. 15, 1917	Conviction.
Melnick, David,	Lawrence,	Lawrence,	Apr. 13, 1917	Conviction.
Miller, Louis,	Boston,	Boston,	Apr. 5, 1917	Conviction.
Reeves, Andrew,	Lawrence,	Lawrence,	June 29, 1917	Conviction.
Rounsevell, Philip W.,	Boston,	Boston,	Apr. 5, 1917	Conviction.
Rounsevell, Philip W.,	Boston,	Boston,	Apr. 5, 1917	Conviction.
Sichel, Herman,	Roxbury,	Somerville,	Dec. 12, 1916	Conviction.[1]
Wild, Arthur T.,	New Bedford,	New Bedford,	Feb. 5, 1917	Conviction.

[Contained coloring matter.]

Name.	Address.	Court.	Date.	Result.
Scholz, Herman,	Lawrence,	Lawrence,	Apr. 20, 1917	Conviction.
Wagner, Robert,	Fitchburg,	Fitchburg,	Apr. 3, 1917	Conviction.

[1] Appealed.

For Sale of Adulterated Foods Other than Milk and Milk Products — Concluded.

SCALLOPS.

[Contained added water.]

Name.	Address.	Court.	Date.	Result.
Ames, Elmer E.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Donellis, John,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Duce, George,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Folsom, Benj. F.,	Boston,	Roxbury,	Dec. 5, 1916	Conviction.
Grant, Arthur B.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Martin, Antonio J.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Mello, Joe M.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Monez, Jose,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Monez, Jose,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Murray, Phillip, Jr.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Pease, Benj. F.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Reis, Manuel,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Rodrigues, John S.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Rowley, Stanley,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Sylvia, Antone C.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Sylvia, Joseph J.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Sylvia, Martin J.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Walters, Samuel,	Roxbury,	Roxbury,	Dec. 19, 1916	Conviction.
Wheldon, Charles G.,	Nantucket,	Nantucket,	May 2, 1917	Conviction.
Williams, Inc., James Frank,	Lynn,	Lynn,	Dec. 13, 1916	Conviction.

For Sale of Decomposed Food.

EGGS.

Best, Joseph P.,	Boston,	Boston,	Mar. 29, 1917	Conviction.
Bloom, Max,	Chelsea,	Chelsea,	May 7, 1917	Conviction.
Dressler, Harry,	Chelsea,	Chelsea,	May 7, 1917	Conviction.
Dressler, Harry,	Chelsea,	Chelsea,	Nov. 3, 1917	Conviction.
Freedman, Harry,	Roxbury,	Roxbury,	Jan. 16, 1917	Conviction.[1]
Freedman-Stahl Baking Company.	Roxbury,	Roxbury,	Jan. 16, 1917	Conviction.[1]
Kechejian, Charles,	Dorchester,	Dorchester,	Feb. 7, 1917	Conviction.[1]
Lebzelter, Benj.,	Chelsea,	Roxbury,	Mar. 30, 1917	Conviction.
Roy, Joseph,	Salem,	Salem,	Jan. 22, 1917	Conviction.[1]

[1] Appealed.

For Sale of Decomposed Food — Concluded.

Meat.

Name.	Address.	Court.	Date.	Result.
Dagnase, Michael,	Lynn,	Lynn,	Mar. 27, 1917	Conviction.
Katz, Philip,	Brockton,	Brockton,	Dec. 1, 1916	Discharged.
Katz, Philip,	Brockton,	Brockton,	Dec. 1, 1916	Conviction.
Katz, Philip,	Brockton,	Brockton,	Dec. 1, 1916	Discharged.
Kotarski, Alexander,	Salem,	Salem,	Jan. 12, 1917	Conviction.

Nuts.

Barzakian, John,	Brookline,	Brookline,	Dec. 26, 1916	Conviction.
Gralton, Philip J.,	Waltham,	Waltham,	Jan. 3, 1917	Conviction.
Jennesco, Patrick,	Mansfield,	Attleboro,	Dec. 27, 1916	Conviction.
Provetzas, Peter,	Natick,	Natick,	Jan. 27, 1917	Conviction.

Potatoes.

Opochinsky, Philip M.,	Boston,	Natick,	Mar. 6, 1917	Conviction.

Shrimp.

Foote, Howard E.,	Attleboro,	Attleboro,	Dec. 27, 1916	Conviction.[1]
Gunsenhiser, Abram,	Boston,	Boston,	Apr. 11, 1917	Conviction.

For Sale of Tubercular Meat.

Goldstein, George,	North Brookfield,	Ware,	June 7, 1917	Conviction.[1]

For Failure to Display Sign "Butterine Sold Here."

Cahan, Michael B.,	Lowell,	Lowell,	Mar. 5, 1917	Conviction.

For Sale of Drugs Deficient in Strength.

Alcohol.

Cashman, Robert E.,	Chelsea,	Chelsea,	June 23, 1917	Conviction.[1]
Goldblat, Harris,	Chelsea,	Chelsea,	June 23, 1917	Conviction.[1]
Lipp, Jacob,	Chelsea,	Chelsea,	June 23, 1917	Conviction.[1]
Narwitz, David,	Chelsea,	Chelsea,	June 23, 1917	Conviction.[1]
Resnek, Louis H.,	Chelsea,	Chelsea,	June 23, 1917	Conviction.[1]

[1] Appealed.

For Sale of Drugs Deficient in Strength — Concluded.

CAMPHORATED OIL.

NAME.	Address.	Court.	Date.	Result.
Burke, John A.,	Milford,	Milford,	Oct. 26, 1917	Conviction.
Farrell, Thomas H.,	Pittsfield,	Pittsfield,	Aug. 3, 1917	Conviction.
Healey, John B.,	Lawrence,	Lawrence,	Nov. 21, 1917	Conviction.
Lamoureaux, Gaspard,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Masse's Pharmacy,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Pharmacie Franciæ,	Lawrence,	Lawrence,	June 15, 1917	Conviction.

SPIRIT OF NITROUS ETHER.

Brown, J. C.,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Collet, C. A.,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Demers, Rosaire,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Dion's Pharmacy,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
James, Frank,	Boston,	Boston,	Feb. 21, 1917	Conviction.
Jansen, C. A.,	New Bedford,	New Bedford,	Oct. 31, 1917	Conviction.
Mazel, George,	New Bedford,	New Bedford,	Oct. 21, 1917	Conviction.
Reenstierna, Ivar,	Boston,	Boston,	Mar. 8, 1917	Conviction.
Ropes Drug Company,	Salem,	Salem,	Nov. 9, 1917	Conviction.
Viens, Arthur,	Nahant,	Lynn,	Oct. 4, 1917	Conviction.
Vincent, Arthur R.,	Holyoke,	Holyoke,	Aug. 10, 1917	Conviction.
Yardumian, Mihran B.,	Boston,	Boston,	Feb. 21, 1917	Conviction.
Yochelman, Isador,	Chelsea,	Chelsea,	Feb. 28, 1917	Dismissed.

TINCTURE OF IODINE.

Carpenter, Orlandi A.,	Charlestown,	Charlestown,	Apr. 23, 1917	Conviction.[1]
Donaghy, William,	Boston,	Dorchester,	Feb. 15, 1917	Conviction.[1]
Shattuck, Gardner,	Malden,	Malden,	Apr. 17, 1917	Conviction.[1]
White, Joseph,	Roxbury,	Roxbury,	May 29, 1917	Conviction.

[1] Appealed.

List of Prosecutions for Violation of the Laws relative to Cold Storage.

For selling Cold-storage Goods without displaying a Sign marked "Cold Storage Goods Sold Here."

Name.	Address.	Court.	Date.	Result.
Ansel, Hyman,	Roxbury,	Roxbury,	Feb. 23, 1917	Conviction.
Baker, Gideon K.,	Brockton,	Brockton,	Feb. 28, 1917	Conviction.
Bundis, William,	Brockton,	Brockton,	Feb. 28, 1917	Conviction.
Booth Fisheries Company,	Boston,	Boston,	Mar. 29, 1917	Conviction.
Cefali, Joseph,	Boston,	Boston,	Mar. 29 1917,	Conviction.
Cherry, Rebecca,	Roxbury,	Roxbury,	Feb. 2, 1917	Conviction.
Coburn, Jos. B. V.,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.
Conway, George F.,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.
Danosky, Hipolop,	Waltham,	Waltham,	Dec. 27, 1916	Conviction.
Flynn, Joseph H.,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.
Kahan, Gabriel,	Lowell,	Lowell,	Mar. 5, 1917	Conviction.
Kahan, Gabriel,	Lowell,	Lawrence,	Mar. 2, 1917	Conviction.
Kazanjian, Ignardios,	Winthrop,	East Boston,	Feb. 12, 1917	Conviction.
Lampos, Thomas,	Brockton,	Brockton,	Feb. 28, 1917	Conviction.
Levins, Abraham D.,	Dorchester,	Dorchester,	Feb. 7, 1917	Conviction.
Mantia, Joseph,	Boston,	Boston,	Mar. 29, 1917	Conviction.
McCann, Thomas A.,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.
Perrault, George O.,	Lowell,	Lowell,	Mar. 12, 1917	Conviction.
Ritvo, William,	Winthrop,	East Boston,	Mar. 6, 1917	Conviction.
Rosenberg, Morris,	Winthrop,	East Boston,	Mar. 6, 1917	Conviction.
Rostler, Samuel H.,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.
Rothberg, Benjamin,	Lowell,	Lowell,	Feb. 7, 1917	Conviction.
Rubin, Lewis,	Chelsea,	Chelsea,	Oct. 24, 1917	Conviction.
Saliba, James,	Lawrence,	Lawrence,	Feb. 15, 1917	Conviction.[1]
Skelly, Gregory S.,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.
Swartz, Philip,	Winthrop,	East Boston,	Feb. 12, 1917	Conviction.[2]
Verrecchia, Florando,	Lawrence,	Lawrence,	Feb. 15, 1917	Conviction.
Vigeant, Ambrose,	Lowell,	Lowell,	Jan. 16, 1917	Conviction.

[1] Appealed

[2] Appealed; later, appeal withdrawn.

For selling, exposing or offering for Sale Cold-storage Eggs without having the Container properly marked.

Name.	Address.	Court.	Date.	Result.
Danosky, Hipolop,	Waltham,	Waltham,	Dec. 27, 1916	Conviction.
Hindman, Harry,	Lawrence,	Lawrence,	Mar. 2, 1917	Conviction.
Jackson, John B.,	New Bedford,	New Bedford,	Jan. 29, 1917	Conviction.
Karras, Abraham,	Winthrop,	East Boston,	Feb. 12, 1917	Conviction.
Kazanjian, Ignardios,	Winthrop,	East Boston,	Feb. 12, 1917	Conviction.
Levins, Abraham D.,	Dorchester,	Dorchester,	Feb. 7, 1917	Conviction.
Paposa, Manuel,	New Bedford,	New Bedford,	Jan. 29, 1917	Conviction.
Perrault, George O.,	Lowell,	Lowell,	Mar. 12, 1917	Conviction.
Pinto, Antone G.,	New Bedford,	New Bedford,	Jan. 29, 1917	Conviction.
Rubin, Lewis,	Chelsea,	Chelsea,	Oct. 24, 1917	Conviction.
Saliba, James,	Lawrence,	Lawrence,	Feb. 15, 1917	Conviction.[1]
Sherividian, Nazarith,	Roxbury,	Roxbury,	Feb. 2, 1917	Conviction.
Swartz, Philip,	Winthrop,	East Boston,	Feb. 12, 1917	Conviction.[2]
Tomasik, Thaddeus,	New Bedford,	New Bedford,	Jan. 29, 1917	Conviction.
Vargos, Manuel,	New Bedford,	New Bedford,	Jan. 29, 1917	Conviction.

For representing Cold-storage Goods as Fresh.

Gelt, Samuel,	Lawrence,	Lawrence,	April 13, 1917	Conviction.

For operating a Cold-storage Warehouse without a License.

Armour & Co.,	Worcester,	Worcester,	Mar. 15, 1917	Dismissed.

List of Prosecutions for Violation of the Laws relative to Slaughtering.

For slaughtering in the Absence of the Inspector.

Name.	Address.	Court.	Date.	Result.
Alpert, Samuel,	Norton,	Attleboro,	Mar. 17, 1917	Conviction.
Barr, Leroy,	North Braintree,	Brookfield,	May 23, 1917	Conviction.
Becker, Sebastian,	Woburn,	Woburn,	Mar. 29, 1917	Conviction.
Blair, Walter,	Middleborough,	Middleborough,	Dec. 2, 1916	Conviction.
Blanchard, Arthur,	Acton,	Concord,	Dec. 18, 1916	Discharged.

[1] Appealed.

[2] Appealed; later, appeal withdrawn.

For slaughtering in the Absence of the Inspector — Concluded.

Name.	Address.	Court.	Date.	Result.
Brothers, Nelson,	Palmer,	Palmer,	Feb. 28, 1917	Discharged.
Foskett, Homer,	Dudley,	Webster,	June 7, 1917	Conviction.
Kemp, Charles H.,	Billerica,	Lowell,	Mar. 20, 1917	Conviction.
Kriger, Benjamin,	Pittsfield,	Pittsfield,	Dec. 8, 1916	Conviction.
Kruger, Henry,	Sterling,	Clinton,	Dec. 28,1916	Conviction.
Longley, Louis F.,	Gloucester,	Gloucester,	Aug. 9, 1917	Conviction.
Longley, Louis F.,	Gloucester,	Salem,	Oct. 5, 1917	Conviction.
Longley, Louis F.,	Gloucester,	Salem,	Oct. 6, 1917	Conviction.
McArdle, Charles,	Burlington,	Woburn,	Feb. 21, 1917	Conviction.
Polcaro, Anthony,	Pittsfield,	Pittsfield,	June 29, 1917	Conviction.
Schnell, Carl,	Pittsfield,	Pittsfield,	June 29, 1917	Conviction.
Steinberg, Max,	Lawrence,	Woburn,	Feb. 21, 1917	Discharged.
Wiegert, George,	Worcester,	Worcester,	May 29, 1917	Conviction.

As Inspector of Slaughtering allowed the Use of Branding Stamp by One Other than an Authorized Agent.

Freeman, Henry S.,	Norton,	Attleboro,	Dec. 29, 1916	Conviction.
Freeman, Henry S.,	Norton,	Attleboro,	Dec. 29, 1916	Conviction.

As Inspector of Slaughtering neglected to comply with the Orders and Regulations as directed by the State Department of Health.

Dudley, Charles A.,	Acton,	Concord,	Dec. 18, 1916	Discharged.
Dudley, Charles A.,	Acton,	Concord,	Dec. 18, 1916	Discharged.
Parker, Henry B.,	Dracut,	Lowell,	June 28, 1917	Conviction.

For Unlawful Use of Branding Stamp.

Alpert, Samuel,	Norton,	Attleboro,	Jan. 6, 1917	Discharged.
Alpert, Samuel,	Norton,	Attleboro,	Mar. 17, 1917	Conviction.[1]
Alpert, Samuel,	Norton,	Attleboro,	Mar. 17, 1917	Conviction.[1]

For having Immature Veal in his Possession with Intent to sell.

Keller, Joseph,	Dracut,	Lowell,	June 28, 1917	Dismissed.
Kremer, Samuel,	Dracut,	Lowell,	June 28, 1917	Conviction.
Verrecchia, Florando,	Lawrence,	Lawrence,	Feb. 20, 1917	Conviction.

[1] Appealed.

For having Uninspected Meat in his Possession with Intent to sell.

Name.	Address.	Court.	Date.	Result.
Becker, Sebastian, . .	Woburn, . .	Woburn, . .	Mar. 29, 1917	Conviction.
Gangi, Pietro, ...	Lawrence, . .	Lawrence, . .	Feb. 20, 1917	Conviction.

For having Unstamped Meat in Possession with Intent to sell.

Catz, Morris, ...	Gloucester, . .	Gloucester, .	Aug. 9, 1917	Discharged.
Friederich, F., ...	Pittsfield, . .	Pittsfield, . .	June 29, 1917	Conviction.
Gruno, H., ...	Pittsfield, . .	Pittsfield, . .	June 29, 1917	Conviction.
Kantrovitz, Zaaval, . .	Pittsfield, . .	Pittsfield, . .	June 22, 1917	Conviction.
Polcaro, Anthony, . .	Pittsfield, . .	Pittsfield, . .	June 29, 1917	Conviction.

For selling Immature Veal.

Brown, Benjamin D., . .	Hudson, . .	Hudson, . .	April 7, 1917	Held for grand jury; no bill.
Holtzman, David, . .	Dracut, . . .	Lowell, . .	June 28, 1917	Conviction.

For selling Uninspected Meat.

Jaffe, Louis, ...	Pittsfield, . .	Pittsfield, . .	June 29, 1917	Dismissed.
Klein, Louis, ...	Pittsfield, . .	Pittsfield, . .	June 29, 1917	Dismissed.
Kriger, Benjamin, . .	Pittsfield, . .	Pittsfield, . .	Dec. 8, 1916	Conviction.
Moskoff, Frank, . . .	Middleborough, .	Middleborough, .	Dec. 2, 1916	Conviction.

For offering Immature Veal for Sale.

Jacobs, Hyman, . . .	Worcester, . .	Worcester, . .	June 13, 1917	Conviction.

For stamping Immature Veal.

Clark, William H., . .	Hudson, . .	Hudson, . .	April 7, 1917	Dismissed.

Tables relating to Laboratory Examinations.

Milk from Milk Dealers.

County.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.	Milk containing Dirt.
Barnstable, . .	75	10	85	11.20	-	5	2	-
Berkshire, . .	203	39	242	8.92	3	7	1	4
Bristol, . . .	296	131	427	7.78	-	6	46	-
Dukes, . . .	28	4	32	11.00	-	-	-	-
Essex, . . .	846	214	1,060	6.34	3	28	14	-
Franklin, . .	25	1	26	11.92	-	-	-	-
Hampden, . .	129	45	174	9.16	1	1	2	-
Hampshire, . .	58	19	77	5.98	-	2	1	-
Middlesex, . .	1,330	384	1,714	8.49	7	27	27	1
Nantucket, . .	46	7	53	10.88	-	-	-	-
Norfolk, . .	451	81	532	8.42	1	15	7	-
Plymouth, . .	284	51	335	9.20	4	5	2	-
Suffolk, . . .	176	28	204	11.00	-	1	-	-
Worcester, . .	485	189	674	7.00	11	16	26	-
Totals, . .	4,432	1,203	5,635	5.98	30	113	128	5

Milk from Suspected Producers.

County.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Pure Milk.	Watered Milk.	Milk containing Dirt.
Barnstable, ...	1	2	3	7.00	-	2	-
Berkshire, ...	4	-	4	12.20	-	1	1
Bristol, ...	41	103	144	6.26	2	41	-
Essex, ...	49	46	95	7.90	-	8	-
Hampden, ...	51	15	66	10.44	-	3	-
Middlesex, ...	206	249	455	7.84	3	141	8
Norfolk, ...	90	64	154	8.52	2	28	-
Plymouth, ...	8	7	15	11.04	-	-	-
Suffolk, ...	-	9	9	10.14	-	9	-
Worcester, ...	57	35	92	9.60	-	8	-
Totals, ...	507	530	1,037	6.26	7	241	9

Summary of Milk Statistics.

MILK.	Above Standard.	Below Standard.	Total.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk not marked.	Watered Milk.	Milk containing Dirt.
Milk from dealers,	4,432	1,203	5,635	5.98	30	113	128	5
Milk from suspected producers.	507	530	1,037	6.26	-	7	241	10
Miscellaneous samples,	233	155	388	8.26	1	5	52	-
Totals,	5,172	1,888	7,060	5.98	31	125	421	15

Milk Statistics by Months.[1]

Month.	Number above Standard.	Number below Standard.	Total Samples collected.	Skimmed Samples marked.	Skimmed Samples not marked.	Watered Samples.	Samples containing Dirt.	Number of Samples with Solids varying between — 15 Per Cent. and above.	14 and 15 Per Cent.	13 and 14 Per Cent.	12 and 13 Per Cent.	11 and 12 Per Cent.	10 and 11 Per Cent.	9 and 10 Per Cent.	8 and 9 Per Cent.	Below 8 Per Cent.
1916.																
December,	288	50	338	1	3	14	–	4	2	63	230	25	5	6	2	1
1917.																
January,	254	76	330	1	–	10	–	–	1	43	241	34	3	4	4	–
February,	291	59	350	1	1	4	–	–	–	56	260	30	4	–	–	–
March,	371	147	518	1	3	30	–	3	9	71	337	79	12	3	2	2
April,	410	207	617	3	12	17	2	1	14	71	399	112	14	6	–	–
May,	604	217	821	2	4	42	–	3	14	82	553	135	26	17	1	–
June,	568	230	798	3	15	83	8	2	12	95	458	173	30	27	1	–
July,	458	241	699	1	30	76	–	3	10	73	372	173	32	12	9	15
August,	358	233	591	3	7	75	–	5	4	51	273	171	42	37	7	1
September,	479	123	602	1	24	19	–	2	10	114	353	92	21	8	–	2
October,	609	140	749	13	18	27	5	11	24	144	425	100	19	16	5	5
November,	397	64	461	–	5	10	–	13	24	119	241	53	9	2	–	–
Totals,	5,087	1,787	6,874	30	122	407	15	47	124	982	4,142	1,177	217	128	31	26

[1] Includes samples collected by inspectors only.

Milk Statistics by Months — Concluded.

Month.	Number.	Average of All Samples.			Number.	Average of All Samples not declared Skimmed or Watered.		
		Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).		Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).
1916.								
December,	338	12.56	3.70	8.86	320	12.70	3.77	8.93
1917.								
January,	330	12.41	3.57	8.84	319	12.51	3.62	8.89
February,	350	12.55	3.62	8.93	344	12.56	3.63	8.93
March,	518	12.39	3.64	8.75	484	12.51	3.68	8.83
April,	617	12.33	3.58	8.75	587	12.46	3.65	8.81
May,	821	12.31	3.63	8.68	773	12.45	3.68	8.77
June,	798	12.25	3.61	8.64	697	12.47	3.69	8.78
July,	699	12.03	3.52	8.51	592	12.28	3.63	8.65
August,	591	11.92	3.53	8.39	506	12.25	3.66	8.59
September,	602	12.43	3.76	8.57	558	12.56	3.84	8.72
October,	749	12.51	3.75	8.76	691	12.69	3.88	8.81
November,	461	12.71	3.79	8.92	446	12.77	3.82	8.95
Totals,	6,874	12.34	3.64	8.70	6,317	12.53	3.73	8.80

Summary of Statistics of Food exclusive of Milk.

Character of Sample.	Genuine.	Adulterated.	Totals.	Character of Sample.	Genuine.	Adulterated.	Totals.
Bakers' supplies,	8	–	8	Horse radish,	2	–	2
Baking powder,	1	–	1	Ice cream,	264	24	288
Bread,	8	–	8	Jams and jellies,	13	–	13
Butter,	12	5	17	Lard,	20	10	30
Buttermilk,	2	2	4	Maple sugar,	37	8	45
Canned goods,	78	16	94	Maple syrup,	5	–	5
Cider,	3	–	3	Meal,	2	–	2
Clams,	1	–	1	Meat products: —			
Cocoa,	4	3	7	Beef,	4	2	6
Coffee,	4	–	4	Hamburg steak,	28	17	45
Condensed milk,	3	–	3	Mince meat,	2	1	3
Condimental sauces,	4	–	4	Pork,	–	1	1
Confectionery,	5	–	5	Sausage,	236	47	283
Cream,	69	3	72	Miscellaneous foods,	6	–	6
Dates,	1	–	1	Molasses,	4	–	4
Eggs,	144	63	307	Nuts,	37	30	67
Fish,	11	5	16	Olive oil,	26	2	28
Flavoring extracts: —				Peanut butter,	9	–	9
Almond,	1	–	1	Pickles,	5	–	5
Banana,	1	–	1	Preservative,	1	–	1
Coffee,	1	–	1	Salad dressing,	4	–	4
Lemon,	12	–	12	Scallops,	89	54	143
Peppermint,	5	–	5	Shortening,	1	1	2
Raspberry,	1	–	1	Shrimp,	19	6	25
Strawberry,	1	–	1	Soft drinks,	16	1	17
Vanilla,	11	–	11	Spices,	36	–	36
Wintergreen,	2	–	2	Tomato soup,	2	–	2
Flour,	3	–	3	Vegetable,	–	1	1
Fruit juices: —				Vinegar,	13	16	29
Lemon,	1	–	1	Wax,	–	1	1
Grape,	1	–	1	Wine,	1	–	1
Honey,	4	1	5	Totals,	1,284	420	1,704

Summary of Drug Statistics.

Character of Sample.	Genuine.	Adulterated.	Totals.
Alcohol, ...	32	15	47
Borax, ...	1	–	1
Denatured alcohol, . .	15	–	15
Disinfectant, ...	1	–	1
Hamamelis water, . . .	8	1	9
Miscellaneous drugs, . .	3	1	4
Oils: —			
Camphorated, ...	141	27	168
Linseed, ...	1	–	1
Olive, ...	28	–	28
Ointments: —			
Blue, ...	1	–	1
Zinc, ...	12	–	12
Prescription, ...	–	1	1

Character of Sample.	Genuine.	Adulterated.	Totals.
Proprietary medicines, . .	6	1	7
Quinine pills, ...	–	1	1
Spirit of —			
Anise, ...	32	9	41
Camphor, ...	84	10	94
Nitrous ether, ...	54	58	112
Peppermint, ...	81	8	89
Wintergreen, ...	7	–	7
Tincture of —			
Ginger, ...	–	1	1
Iodine, ...	142	12	154
Totals, ...	649	145	794

Summary of Liquor Statistics.

Locality.	Beer.	Cider.	Wine.	Distilled Liquors.	Miscellaneous and Remarks.	Totals.
Ayer, ...	–	–	–	–	1 (Sanford's Ginger), . . .	1
Barnstable, ...	–	1	–	–	– –	1
Beverly, ...	–	–	1	–	– –	1
Boston, ...	9	–	2	1	– –	12
Byfield, ...	–	1	–	–	– –	1
Cambridge, ...	1	–	1	1	– –	3
Danvers, ...	–	2	–	–	– –	2
Fall River, ...	11	4	1	–	– –	16
Fitchburg, ...	–	–	1	–	– –	1
Framingham, ...	–	1	–	–	– –	1
Franklin, ...	2	–	–	–	– –	2
Groveland, ...	–	2	–	–	– –	2
Haverhill, ...	–	–	–	2	– –	2
Leominster, ...	3	–	–	–	– –	3
Lowell, ...	4	–	–	–	– –	4
Lynn, ...	4	9	–	2	– –	15
Mansfield, ...	–	–	1	–	– –	1
Middleton, ...	–	1	–	–	– –	1
Newburyport, ...	–	3	–	–	– –	3
North Adams, ...	–	–	1	–	– –	1
Quincy, ...	–	1	4	–	– –	5
Revere, ...	1	–	–	–	– –	1
Springfield, ...	1	–	–	–	– –	1
Taunton, ...	–	–	–	–	1 (sink draining), ...	1
Wareham, ...	–	–	1	–	– –	1
Wellesley, ...	1	–	–	–	– –	1
Weymouth, ...	–	–	4	–	– –	4
Worcester, ...	–	1	–	–	– –	1
Totals, ...	37	26	17	6	2 – –	88

Summary of Poison Statistics.

Character of Sample.	Andover Police.	Boston Police.	Brookline Police.	Cambridge Police.	Miscellaneous Sources.	State Police.	Watch and Ward Society.	Worcester Police.	Totals.
Cocaine and its salts,	–	47	–	1	–	–	–	–	48
Morphine and its salts,	–	190	–	1	–	–	–	–	191
Morphine derivative,	–	5	–	–	–	–	–	–	5
Heroin tablets or powder,	–	6	–	–	–	–	–	–	6
Opium,	–	2	–	–	–	–	–	–	2
Alleged poisons,	1	14	1	–	1	1	1	1	20
Totals,	1	264	1	2	1	1	1	1	272

General Summary of Analyses.

	Legal.	Illegal.	Totals.
Milk,	5,172	1,888	7,060
Foods, exclusive of milk,	1,284	420	1,704
Drugs,	649	145	794
Totals,	7,105	2,453	9,558
Poisons,	15	257	272
Liquors,	32	56	88
Linseed oil and turpentine,	11	–	11
Totals,	7,163	2,766	9,929

Extension of Time in Cold Storage.

Summary.

Requests for extension of time granted,		180
Eggs,	2	
Butter,	3	
Poultry,	143	
Game,	1	
Meat,	20	
Fish,	9	
Strawberries,	2	
Requests for extension of time not granted,		18
Egg whites,	1	
Poultry,	10	
Meat,	5	
Fish,	1	
Strawberries,	1	
Requests for permission to remove granted		8
Butter,	1	
Poultry,	4	
Meat,	3	
Directed to remove (no requests made),		40
Eggs,	2	
Butter,	4	
Poultry,	13	
Game,	3	
Meat,	9	
Fish,	9	

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1916, to Dec. 1, 1917.

[Reason for such extension being that goods were in proper condition for further storage.]

Article.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Eggs, broken out, .	120	Mar. 30, 1916	May 1, 1917	Fairmont Creamery Company.
Eggs, broken out, .	–	May 29, 1916	– –[1]	State Department of Health.
Butter, . . .	1,560	Aug. 19, 1916	Jan. 1, 1918	Doe, Sullivan & Co.
Butter, . . .	900	June 8, 1916	July 20, 1917	Goldsmith-Wall-Stockwell Company.
Butter, . . .	180	June 26, 1916	Aug. 26, 1917	Howe Lumber Company.
Broilers, . . .	754	Nov. 15, 1916	Dec. 15, 1917	Borst, Pierce Company.
Broilers, . . .	90	Nov. 15, 1916	Dec. 15, 1917	Borst, Pierce Company.
Broilers, . . .	133	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Broilers, . . .	423	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Broilers, . . .	504	Nov. 15, 1916	Dec. 15, 1917	Borst, Pierce Company.
Broilers, . . .	717	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Broilers, . . .	1,022	Sept. 28, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	417	Sept. 29, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	367	Sept. 30, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	299	Oct. 3, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	299	Oct. 3, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	1,842	Oct. 4, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	205	Oct. 5, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	481	Oct. 5, 1916	Jan. 1, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	92	Oct. 9, 1916	Nov. 15, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	301	Oct. 9, 1916	Nov. 15, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	2,094	Oct. 9, 1916	Feb. 15, 1918	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	180	Oct. 11, 1916	Nov. 15, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	1,254	Oct. 14, 1916	Nov. 15, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	724	Oct. 16, 1916	Nov. 15, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	340	Oct. 17, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	300	Oct. 17, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	296	Oct. 19, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	179	Nov. 2, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	178	Nov. 2, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Broilers, . . .	1,513	Oct. 27, 1916	Feb. 1, 1918	Hosmer, F. H., & Co.
Broilers, . . .	1,017	Oct. 31, 1916	Dec. 1, 1917	Hosmer, F. H., & Co.
Broilers, . . .	1,572	Nov. 3, 1916	Dec. 3, 1917	Hosmer, H. L., Company.
Broilers, . . .	2,181	May 16, 1916	Aug. 16, 1917	Swan, Newton & Co.
Broilers, . . .	1,067	Sept. 25, 1916	Dec. 25, 1917	Swan, Newton & Co.

[1] Extension granted indefinitely.

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1916, to Dec. 1, 1917 — Continued.

Article.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Broilers, . . .	200	Oct. 11, 1916	Feb. 10, 1918	Swan, Newton & Co.
Broilers, . . .	789	Oct. 13, 1916	Nov. 15, 1917	Swan, Newton & Co.
Broilers, . . .	478	Oct. 20, 1916	Nov. 22, 1917	Swan, Newton & Co.
Broilers, . . .	202	Oct. 23, 1916	Nov. 22, 1917	Swan, Newton & Co.
Broilers, . . .	336	Oct. 25, 1916	Nov. 22, 1917	Swan, Newton & Co.
Broilers, . . .	206	Nov. 16, 1916	Dec. 16, 1917	Swan, Newton & Co.
Broilers, . . .	351	Nov. 16, 1916	Dec. 16, 1917	Swan, Newton & Co.
Broilers, . . .	745	Nov. 17, 1916	Dec. 16, 1917	Swan, Newton & Co.
Broilers, . . .	340	Nov. 23, 1916	Jan. 1, 1918	Swan, Newton & Co.
Broilers, . . .	547	Sept. 22, 1916	Dec. 22, 1917	Wilcox, Charles A., Company.
Broilers, . . .	2,059	Sept. 26, 1916	Dec. 26, 1917	Wilcox, Charles A., Company.
Chickens, . . .	3,025	Nov. 15, 1916	Dec. 15, 1917	Borst, Pierce Company.
Chickens, . . .	534	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Chickens, . . .	3,310	Nov. 28, 1916	Mar. 28, 1918	Borst, Pierce Company.
Chickens, . . .	169	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Chickens, . . .	194	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Chickens, . . .	[1] 1,403	Nov. 14, 1916 Nov. 22, 1916 Nov. 25, 1916	Dec. 14, 1917 Dec. 14, 1917 Mar. 14, 1918	Corwin, C. R. Company.
Chickens, . . .	17,000	Oct. 9, 1916	Nov. 9, 1917	Armour & Co.
Chickens, . . .	16,000	Oct. 9, 1916	Jan. 9, 1918	Armour & Co.
Chickens, . . .	742	Oct. 10, 1916	Nov. 10, 1917	Batchelder & Snyder Company.
Chickens, . . .	221	Oct. 10, 1916	Nov. 10, 1917	Batchelder & Snyder Company.
Chickens, . . .	131	Oct. 10, 1916	Feb. 10, 1918	Batchelder & Snyder Company.
Chickens, . . .	106	Oct. 31, 1916	Nov. 30, 1917	Batchelder & Snyder Company.
Chickens, . . .	172	Oct. 31, 1916	Feb. 28, 1918	Batchelder & Snyder Company.
Chickens (Guinea), .	426	Nov. 3, 1916	Dec. 3, 1917	Batchelder & Snyder Company.
Chickens (Guinea), .	205	Nov. 7, 1916	Mar. 7, 1918	Batchelder & Snyder Company.
Chickens, . . .	259	Oct. 4, 1916	Feb. 1, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	810	Oct. 14, 1916	Nov. 15, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	333	Oct. 16, 1916	Feb. 15, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	521	Oct. 16, 1916	Feb. 15, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	30	Oct. 18, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	283	Oct. 24, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	182	Oct. 24, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	133	Oct. 24, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.

[1] Extension of one month granted on 15 boxes and four months on 14 boxes.

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1916, to Dec. 1, 1917 — Continued.

Article.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Chickens, . . .	191	Oct. 24, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	69	Oct. 25, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	122	Oct. 26, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	298	Oct. 26, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	530	Oct. 28, 1916	Mar. 15, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	2,820	Oct. 28, 1916	Feb. 28, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	904	Oct. 28, 1916	Feb. 28, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	450	Oct. 28, 1916	Feb. 10, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	600	Oct. 31, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	164	Oct. 31, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	841	Oct. 31, 1916	Nov. 25, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	703	Oct. 31, 1916	Feb. 10, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	110	Nov. 2, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	480	Nov. 7, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	921	Nov. 7, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	2,335	Nov. 10, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	147	Nov. 11, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	248	Nov. 13, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	1,363	Nov. 13, 1916	Mar. 15, 1918	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	186	Nov. 18, 1916	Dec. 10, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	780	Nov. 20, 1916	Dec. 20, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	4,345	Nov. 24, 1916	Dec. 24, 1917	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	6,700	Sept. 11, 1916	Nov. 1, 1917	Eastern Cold Storage Company.
Chickens, . . .	193	July 21, 1916	Aug. 1, 1917	Hosmer, F. H., & Co.
Chickens, . . .	198	Sept. 19, 1916	Dec. 19, 1917	Swan, Newton & Co.
Chickens, . . .	580	Sept. 21, 1916	Dec. 21, 1917	Swan, Newton & Co.
Chickens, . . .	193	Sept. 22, 1916	Dec. 22, 1917	Swan, Newton & Co.
Chickens, . . .	613	Sept. 25, 1916	Dec. 25, 1917	Swan, Newton & Co.
Chickens, . . .	188	Sept. 27, 1916	Dec. 27, 1917	Swan, Newton & Co.
Chickens, . . .	61	Sept. 27, 1916	Dec. 27, 1917	Swan, Newton & Co.
Chickens, . . .	350	Sept. 28, 1916	Dec. 28, 1917	Swan, Newton & Co.
Chickens, . . .	250	Sept. 28, 1916	Dec. 28, 1917	Swan, Newton & Co.
Chickens, . . .	191	Sept. 29, 1916	Dec. 29, 1917	Swan, Newton & Co.
Chickens, . . .	415	Oct. 3, 1916	Feb. 10, 1918	Swan, Newton & Co.
Chickens, . . .	152	Oct. 4, 1916	Feb. 10, 1918	Swan, Newton & Co.
Chickens, . . .	208	Oct. 4, 1916	Feb. 10, 1918	Swan, Newton & Co.
Chickens, . . .	380	Oct. 4, 1916	Feb. 10, 1918	Swan, Newton & Co.

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1916, to Dec. 1, 1917 — Continued.

Article.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Chickens, . . .	196	Oct. 5, 1916	Feb. 10, 1918	Swan, Newton & Co.
Chickens, . . .	203	Oct. 6, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	1,320	Oct. 9, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	330	Oct. 9, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	349	Oct. 10, 1916	Feb. 10, 1918	Swan, Newton & Co.
Chickens, . . .	200	Oct. 11, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	446	Oct. 11, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	2,123	Oct. 11, 1916	Feb. 10, 1918	Swan, Newton & Co.
Chickens, . . .	128	Oct. 13, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	372	Oct. 16, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	457	Oct. 17, 1916	Nov. 15, 1917	Swan, Newton & Co.
Chickens, . . .	1,400	Oct. 20, 1916	Feb. 23, 1918	Swan, Newton & Co.
Chickens, . . .	193	Oct. 23, 1916	Nov. 22, 1917	Swan, Newton & Co.
Chickens, . . .	206	Oct. 24, 1916	Nov. 22, 1917	Swan, Newton & Co.
Chickens, . . .	378	Oct. 24, 1916	Nov. 22, 1917	Swan, Newton & Co.
Chickens, . . .	2,200	Oct. 24, 1916	Feb. 23, 1918	Swan, Newton & Co.
Chickens, . . .	338	Oct. 24, 1916	Nov. 22, 1917	Swan, Newton & Co.
Chickens, . . .	937	Oct. 25, 1916	Nov. 22, 1917	Swan, Newton & Co.
Chickens, . . .	968	Nov. 1, 1916	Mar. 7, 1918	Swan, Newton & Co.
Chickens, . . .	622	Nov. 13, 1916	Mar. 17, 1918	Swan, Newton & Co.
Chickens, . . .	150	Nov. 15, 1916	Dec. 16, 1917	Swan, Newton & Co.
Chickens, . . .	182	Nov. 17, 1916	Dec. 16, 1917	Swan, Newton & Co.
Chickens, . . .	601	Sept. 16, 1916	Dec. 16, 1917	Wilcox, Charles A., Company.
Chickens, . . .	1,524	Sept. 22, 1916	Dec. 22, 1917	Wilcox, Charles A., Company.
Chickens, . . .	1,882	Sept. 22, 1916	Dec. 22, 1917	Wilcox, Charles A., Company.
Fowls, . . .	216	Nov. 15, 1916	Dec. 15, 1917	Borst, Pierce Company.
Fowls, . . .	616	Nov. 28, 1916	Dec. 28, 1917	Borst, Pierce Company.
Geese, . . .	3,606	Nov. 15, 1916	Mar. 15, 1918	Dorr, Arthur E., & Co., Inc.
Turkeys, . . .	4,863	Nov. 22, 1916	Dec. 1, 1917	Hinrichs, George F., Inc.
Turkeys, . . .	7,117	Nov. 22, 1916	Dec. 1, 1917	Hinrichs, George F., Inc.
Turkeys, . . .	2,080	Nov. 23, 1916	Dec. 1, 1917	Hinrichs, George F., Inc.
Turkeys, . . .	3,531	Nov. 23, 1916	Dec. 1, 1917	Hinrichs, George F., Inc.
Turkeys, . . .	2,938	Nov. 23, 1916	Dec. 1, 1917	Hinrichs, George F., Inc.
Turkeys, . . .	2,287	Nov. 23, 1916	Dec. 1, 1917	Hinrichs, George F., Inc.
Turkeys, . . .	4,211	Nov. 13, 1916	Dec. 15, 1917	Murray, S. E., Company.
Turkeys, . . .	1,192	Nov. 13, 1916	Dec. 15, 1917	Murray, S. E., Company.
Turkeys, . . .	870	Nov. 13, 1916	Dec. 15, 1917	Murray, S. E., Company.

Requests for Extension of Time granted on Goods in Cold Storage from Dec. 1, 1916, to Dec. 1, 1917 — Concluded.

Article.	Weight (Pounds).	Placed in Storage.	Extension granted to —	Name.
Turkeys,	4,520	Nov. 16, 1916	Dec. 15, 1917	Murray, S. E., Company.
Turkeys,	1,401	Nov. 16, 1916	Dec. 15, 1917	Murray, S. E., Company.
Turkeys,	1,032	Nov. 17, 1916	Dec. 15, 1917	Murray, S. E., Company.
Turkeys,	814	Nov. 17, 1916	Dec. 15, 1917	Murray, S. E., Company.
Turkeys,	193	Nov. 17, 1916	Dec. 15, 1917	Murray, S. E. Company.
Bear,	217	July 31, 1916	Jan. 31, 1918	Batchelder & Snyder Company.
Beef shoulders,	936	Oct. 4, 1916	Nov. 11, 1917	Dorr, Arthur E., & Co., Inc.
Beef quarters,	10,299	Nov. 1, 1916	Jan. 3, 1918	Morris & Co.
Beef quarters,	18,887	Nov. 3, 1916	Jan. 3, 1918	Morris & Co.
Frogs' legs,	200	Mar. 27, 1916	June 4, 1917	Hunt, Cassius, Company.
Lamb,	288	Nov. 16, 1916	Jan. 15, 1918	Bay State Fishing Company.
Lamb,	145	Nov. 21, 1916	Jan. 15, 1918	Bay State Fishing Company.
Lamb,	153	Nov. 23, 1916	Jan. 15, 1918	Bay State Fishing Company.
Lamb,	60	Aug. 30, 1916	Sept. 28, 1917	Harvard Provision Company.
Lamb,	75	July 19, 1916	Sept. 25, 1917	Quincy Market Cold Storage and Warehouse Company.
Livers, calves',	394	May 31, 1916	July 1, 1917	Dorr, Arthur E., & Co., Inc.
Livers, calves',	320	June 1, 1916	July 1, 1917	Dorr, Arthur E., & Co., Inc.
Pork,	5,282	Nov. 15, 1916	Dec. 15, 1917	Handy, H. L., Company.
Pork,	1,242	Feb. 2, 1916	May 2, 1917	Penley, E. W.
Pork,	8,430	Feb. 16, 1916	Feb. 28, 1917	Squire, John P., & Co.
Pork loins,	1,300	Jan. 12, 1916	April 1, 1917	Penley, E. W.
Pork loins,	2,800	Jan. 17, 1916	April 1, 1917	Penley, E. W.
Pork loins,	4,500	Jan. 21, 1916	April 1, 1917	Penley, E. W.
Pork loins,	3,500	Jan. 26, 1916	April 1, 1917	Penley, E. W.
Sweetbreads,	350	Oct. 9, 1916	Jan. 9, 1918	Dorr, Arthur E., & Co., Inc.
Veal,	100	July, 1916	Sept. 25, 1917	Quincy Market Cold Storage and Warehouse Company.
Cod,	3,055	June 28, 1916	Aug. 28, 1917	Schoenberger, E., & Co.
Haddock,	765	Aug. 8, 1916	Nov. 8, 1917	Shore Fish Company.
Herring (bait),	6,000	Nov. 10, 1916	May 10, 1918	Bunting & Emery Company.
Lemon sole,	1,891	May 26, 1916	July 1, 1917	Rush Fish Company.
Mackerel,	25	Aug. 28, 1916	Sept. 28, 1917	Harvard Provision Company.
Mackerel,	3,330	June 22, 1916	July 23, 1917	Foley, M. F., & Co.
Mackerel,	2,800	June 23, 1916	July 23, 1917	Foley, M. F., & Co.
Shad,	245	July 27, 1916	Oct. 27, 1917	Commonwealth Ice and Cold Storage Company.
Shad,	645	July 29, 1916	Oct. 27, 1917	Commonwealth Ice and Cold Storage Company.
Strawberries (40 crates),	–	June 27, 1916	July 27, 1917	Bushway Ice Cream Company.
Strawberries (17 crates),	–	June 28, 1916	July 27, 1917	Bushway Ice Cream Company.

Requests for Extension of Time not granted on Goods in Cold Storage from Dec. 1, 1916, to Dec. 1, 1917.

Article.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Egg whites, . .	90	Sept. 7, 1917	Aug. 30, 1917[1]	American Egg Company.
Broilers, . . .	180	Sept. 19, 1916	Sept. 24, 1917[1]	Swan, Newton & Co.
Chickens, . . .	125	Oct. 16, 1916	Oct. 18, 1917[1]	Dorr, Arthur E., & Co., Inc.
Chickens (Guinea), .	46	Nov. 21, 1916	Nov. 26, 1917[1]	Dorr, Arthur E., & Co., Inc.
Chickens, . . .	635	Oct. 6, 1916	Oct. 15, 1917[1]	Swan, Newton & Co.
Chickens, . . .	170	Oct. 6, 1916	Oct. 15, 1917	Swan, Newton & Co.
Chickens, . . .	60	Oct. 16, 1916	Oct. 18, 1917[1]	Swan, Newton & Co.
Chickens, . . .	448	Oct. 19, 1916	Oct. 30, 1917[1]	Swan, Newton & Co.
Chickens, . . .	528	Oct. 25, 1916	Oct. 18, 1917	Swan, Newton & Co.
Chickens, . . .	198	Nov. 14, 1916	Nov. 14, 1917[2]	Swan, Newton & Co.
Turkeys, . . .	1,800	Dec. 27, 1915	Jan. 2, 1917[2]	Cudahy Packing Company.
Beef, ...	597	Oct. 10, 1916	Nov. 1, 1917[1]	Dorr, Arthur E., & Co., Inc.
Beef, ...	601	Oct. 14, 1916	Nov. 1, 1917[1]	Dorr, Arthur E., & Co., Inc.
Beef, ...	624	Oct. 21, 1916	Nov. 1, 1917[1]	Dorr, Arthur E., & Co., Inc.
Calves' heads, . .	229	Jan. 25, 1916	April 1, 1917[3]	Davis Brothers.
Pork loins, . . .	10,558	Nov. 14, 1916	Nov. 22, 1917	Handy, H. L., Company.
Swordfish, . . .	392	Aug. 15, 1916	Aug. 29, 1917	Commonwealth Ice and Cold Storage Company.
Strawberries (2 crates),	-	June 28, 1916	June 28, 1917[1]	Bushway Ice Cream Co.

[1] Not in proper condition. [2] Dried out. [3] Already in storage fourteen months.

Requests granted for Permission to remove Articles which had been in Cold Storage longer than Twelve Months from Dec. 1, 1916, to Dec. 1, 1917.

Article.	Weight (Pounds).	Placed in Storage.	Permission to remove.	Name.
Butter, . . .	30	July 4, 1916	Aug. 1, 1917	Boston Terminal Refrigerating Company.
Broilers, . . .	108	Oct. 11, 1916	Oct. 30, 1917	Smith, A. M., & Co.
Ducks, . . .	54	Aug. 12, 1916	Nov. 10, 1917	Hosmer, F. H., Company.
Roosters, . . .	180	Jan. 5, 1916	Jan. 23, 1917	Brownell, Boston Company.
Turkeys, . . .	307	Nov. 4, 1916	Nov. 20, 1917	Burr, S. L., & Co.
Mutton chops,[1] . .	200	April 1, 1916	Nov. 10, 1917	Boston Terminal Refrigerating Company.
Venison, . . .	40	Dec. 2, 1914	April 10, 1917	Whitney, Walter F.
Suet, ...	100	Jan. 26, 1915	Aug. 8, 1917	Quincy Market Cold Storage and Warehouse Company.

[1] Located in warehouse the latter part of October.

Articles which had been in Cold Storage longer than Twelve Months, and on which no Requests for Extension had been made, ordered removed from Dec. 1, 1916, to Dec. 1, 1917.

Article.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Eggs, frozen,	75	Oct. 11, 1916	Oct. 30, 1917	American Egg Company.
Egg whites,	840	July 28, 1916	Aug. 15, 1917	Goldsmith-Wall Stockwell Company.
Butter,	100	May 4, 1916	May 21, 1917	Industrial School for Boys.
Butter,	30	July 11, 1916	July 18, 1917	McCarthy, F. J.
Butter,	518	July 6, 1916	July 18, 1917	Osgood, C. H.
Butter,	150	Sept. 28, 1915	June 5, 1917	Walker Brothers.
Broilers,	180	Oct. 11, 1916	Nov. 1, 1917	Dorr, Arthur E., & Co., Inc.
Broilers,	60	Oct. 27, 1916	Nov. 23, 1917	Dorr, Arthur E., & Co., Inc.
Broilers,	134	Sept. 27, 1916	Oct. 17, 1917	Strong, Marson Company.
Broilers,	67	Sept. 27, 1916	Oct. 17, 1917	Strong, Marson Company.
Broilers,	650	Oct. 27, 1916	Nov. 15, 1917	Strong, Marson Company.
Chickens,	63	Nov. 2, 1916	Nov. 23, 1917	Dorr, Arthur E., & Co., Inc.
Chickens (Guinea),	676	Nov. 4, 1916	Nov. 23, 1917	Dorr, Arthur E., & Co., Inc.
Chickens,	45	July 5, 1916	July 17, 1917	Harvard Provision Company.
Chickens,	82	Aug. 2, 1916	Aug. 19, 1917	Lawrence, J. P., & Co.
Chickens,	63	Aug. 3, 1916	Aug. 19, 1917	Lawrence, J. P., & Co.
Chickens,	125	Oct. 24, 1916	Nov. 15, 1917	Strong, Marson Company.
Ducks,	360	Aug. 24, 1916	Sept. 18, 1917	Moore, J. E.
Squab,	300	Nov. 20, 1916	Nov. 30, 1917	Batchelder & Snyder Company.
Venison,	35	Nov. 18, 1915	Jan. 2, 1917	Wood, R. A.
Venison,	10	Mar. 30, 1916	June 5, 1917	Crossley, William.
Miscellaneous game,	25	Feb. 25, 1914	May 18, 1917	Manchester, Abraham.
Beef,	4,996	Oct. 31, 1916	Nov. 23, 1917	Morris & Co.
Beef livers,	95	Mar. 2, 1916	June 5, 1917	Cohen, S.
Beef livers,	200	Feb. 17, 1916	June 5, 1917	Nizalovsky, R.
Beef loins,	840	May 16, 1916	May 28, 1917	Dorr, Arthur E., & Co., Inc.
Frogs' legs,	300	Oct. 10, 1916	Nov. 30, 1917	Batchelder & Snyder Company.
Livers, calves',	170	May 13, 1916	May 28, 1917	Dorr, Arthur E., & Co., Inc.
Pork, Loins,	420	Dec. 29, 1915 Mar. 20, 1916	May 28, 1917	Janorin, J. D. L.
Sweetbreads,	180	Nov. 17, 1916	Nov. 30, 1917	Wilson & Co.
Veal,	40	Sept. 4, 1915	June 5, 1917	Morris & Co.
Ciscoes,	500	Sept. 8, 1916	Sept. 22, 1917	Booth Fisheries Company.
Eels, sand,	30	Aug. 29, 1916	Sept. 18, 1917	Calamotti, G.
Eels, sand,	170	Sept. 1, 1916	Sept. 18, 1917	Mantia, G.

Articles which had been in Cold Storage longer than Twelve Months and on which no Requests for Extension had been made, ordered removed from Dec. 1, 1916, to Dec. 1, 1917 — Concluded.

Article.	Weight (Pounds).	Placed in Storage.	Directed to remove.	Name.
Herring, Sardine,	1,750	Oct. 27, 1916	Nov. 23, 1917	Tocco, Joe.
Lakefish,	100	May 6, 1916	May 15, 1917	Kaplin, Isaac.
Mackerel,	50	Oct. 9, 1916	Nov. 3, 1917	Cann's Sea Grill.
Salmon,	13	Oct. 16, 1916	Nov. 23, 1917	Harvard Provision Company.
Squid,	70	Aug. 29, 1916	Sept. 18, 1917	Calamotti, G.
Trout,	100	Aug. 4, 1916	Aug. 21, 1917	Booth Fisheries Company.

Articles placed in Cold Storage from Oct. 1, 1916, to Dec. 1, 1917.

Articles.	October, November, December, 1916.	January, February, March, 1917.	April, 1917.	May, 1917.	June, 1917.	July, 1917.	August, 1917.	September, 1917.	October, 1917.	November, 1917.	Totals.
Eggs, case (dozens),	1,445,124	738,090	4,780,860	8,808,469	5,728,268	1,062,210	352,510	832,470	472,680	123,064	24,343,745
Eggs, broken out (pounds),	441,126	384,521	121,310	192,619	185,079	184,613	116,500	179,314	43,405	165,401	2,013,888
Butter (pounds),	4,203,239	2,428,932	857,921	1,944,153	8,729,509	9,591,786	5,996,277	3,367,935	2,578,767	1,175,219	40,873,738
Poultry (pounds),	12,711,078	4,741,538½	534,279	701,605	729,764	762,887½	370,136	456,545	626,171½	836,501	22,470,505½
Game (pounds),	47,977	24,961	4,443	264	864	1,157	422	2,169	7,612	7,011	96,880
Meat, fresh, and meat products, fresh (pounds).	14,546,360	14,808,466¾	7,592,990¾	6,717,471½	6,021,816	3,100,358¼	4,053,333	4,641,280	6,920,079	9,313,128	77,715,283¼
Fish, fresh food (pounds),	7,379,174	4,761,660	2,141,639	6,328,795	10,065,345	5,164,944	3,789,216	8,088,448½	2,600,520	2,926,870	53,246,611½
Totals,	40,774,078 [1]	27,888,169¼ [1]	16,033,442¾	24,693,376½	31,460,645	19,867,955¾	14,678,394	17,568,161½	13,249,234½	14,547,194	220,760,651¼

[1] Beginning April 1, 1917, cold-storage reports were required to be filed monthly instead of quarterly.

Butter and Eggs held in Cold Storage from Jan. 1, 1917, through Dec. 1, 1917.

	Jan. 1, 1917.	April 1, 1917.	May 1, 1917.	June 1, 1917.	July 1, 1917.	Aug. 1, 1917.	Sept. 1, 1917.	Oct. 1, 1917.	Nov. 1, 1917.	Dec. 1, 1917.
Eggs, case (dozens),	2,785,207	134,495	–[1]	13,148,449	18,451,749	18,627,250	17,053,573	15,390,463	12,944,030	9,068,034
Eggs, broken out (pounds),	292,568	180,344	–[1]	369,952	517,364	650,096	652,541	668,418	538,618	493,033
Butter (pounds),	12,621,368	1,745,448	–[1]	1,544,756	9,033,061	17,073,701	19,784,394	20,120,210	18,951,492	15,690,194
Totals,[1]	15,699,143	2,060,287	–[1]	15,063,157	28,002,174	36,351,047	37,490,508	36,179,091	32,434,140	25,251,261

[1] The warehouses were not required to give these figures as the law requiring monthly reports did not go into effect until May 5, 1917.

Slaughtering Inspection.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Abington,	89	213	385	1[1]	8 tuberculosis,	2 immature, 1 tuberculosis,	– –[2]	– –
Acton,	956	1,402	218	11	19 tuberculosis, 1 died otherwise than by slaughter.	31 immature,	6 urticaria,	– –
Acushnet,	51	271	411	5	2 tuberculosis, 2 paralysis,	2 immature,	2 tuberculosis,	– –
Adams,	23	694	213	5	1 tuberculosis,[2]	2 immature,	2 hog cholera, 1 rheumatism.	– –
Agawam,	859	789	66	69	12 tuberculosis,	6 immature,	2 pyæmia,	– –
Alford,	115	53	87	39	1 tuberculosis, 1 injured,	1 injured,	1 tuberculosis,	– –
Amesbury,	7	32	177	–	– –	– –	1 hog cholera, 1 tumor,	– –
Amherst,	9	64	180	–	– –[2]	– –	– –	– –
Andover,	–	17	102	–	– –	– –	3 tuberculosis, 1 jaundice,	– –
Arlington,	–	2,393	16	1	– –	28 immature,	– –	– –
Ashburnham,	19	23	94	2	– –	– –	1 hog cholera,	– –
Ashby,	145	590	318	5	1 tuberculosis, 2 anæmia, 1 septicæmia.	– –	– –	– –
Ashfield,	58	48	357	6	– –	– –	– –	– –
Ashland,	5	22	294	–	1 tuberculosis,	– –	1 tuberculosis,	– –
Athol,	215	356	398	7	9 tuberculosis,	3 immature,	– –	– –

[1] Goat.

[2] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Attleboro,	204	172	634	-	3 tuberculosis, 2 abscesses, 1 tumor, 1 tetanus.	-	8 hog cholera, 3 tuberculosis, 1 pneumonia, 1 septicæmia, 1 abscess.	-
Auburn,	378	491	235	6	4 tuberculosis, 1 advanced pregnancy.	2 immature, 2 jaundice, 1 septicæmia.	2 tuberculosis,	-
Avon,	1	-	4	-	-	-	-	-
Ayer,	2	-	42	-	-	4 immature,	- [1]	-
Barnstable,	28	163	404	5	-	-	-	-
Barre,	23	27	117	15	-	-	-	-
Becket,	12	15	46	23	-	-	-	-
Bedford,	-	-	30	-	-	-	-	-
Belchertown,	94	118	373	-	-	-	2 tuberculosis,	-
Bellingham,	2	-	18	-	1 tuberculosis, 1 strangulation.	-	-	-
Belmont,	3	-	118	-	-	-	-	-
Berkley,	1	1	122	-	-	-	-	-
Berlin,	16	31	139	8	-	-	-	-
Bernardston,	72	266	232	43	1 tuberculosis,	1 immature,	1 tuberculosis,	-
Beverly,	1	1	30	-	-	-	-	-
Billerica,	114	209	120	-	11 tuberculosis,	14 immature,	1 tuberculosis,	-
Blackstone,	9	6	6	-	2 tuberculosis,	-	-	-
Blandford,	12	55	128	12	2 tuberculosis,	-	-	-

Bolton, ...	3	-	112	-	-	-	-	-	-
Bourne, ...	5	21	159	-	1 indigestion, . . .	-	-	-	-
Boxborough, . . .	5	312	62	5	-	-	-	-	-
Boxford, ...	254	508	280	-	4 died otherwise than by slaughter.	10 immature, . . .	-	-	-
Boylston, ...	428	556	201	-	2 tuberculosis, . . .	3 immature, . . .	-	-	-
Braintree, ...	17	114	420	1	-	3 immature, . . .	-	-	-
Brewster, ...	2	39	118	2	-	1 nephritis, 1 decomposed, .	-	-	-
Bridgewater, . . .	3	17	186	-	-	-	-	-	-
Brimfield, ...	6	12	152	-	-	-	-	-	-
Brockton, . . .	732	594	1,050	2[2]	1 tuberculosis, . . .	3 immature, . . .	1 enteritis, 3 tuberculosis, .	-	-
Brookfield, . . .	21	99	199	33	-	1 immature, 1 injured, .	2 hog cholera, . . .	-	-
Brookline, ...	-	-	-	-	-	-	-	-	-
Buckland, ...	6	-	57	-	-	-	-	-	-
Burlington, . . .	-	142	447	-	-	-	-	-	-
Cambridge, . . .	-	14,281	-	-	-	371 immature, 6 emaciated, 25 bruised, 46 weak condition, 2 jaundice, 2 umbilical abscesses, 3 phlebitis, 2 polyarthritis, 1 dysentery.	-	-	-
Canton, ...	-	-	222	-	-	-	-	-	-
Carlisle, ...	2	-	3	-	-	-	-	-	-
Carver, ...	75	434	20	3	-	12 immature, . . .	-	-	-
Charlemont, . . .	6	8	31	5	-	-	-	-	-
Charlton, ...	238	688	332	9	1 tuberculosis, . . .	-	-	-	-
Chatham, ...	3	23	120	-	-	-	-	-	-

[1] Certain organs or parts condemned.

[2] Goats.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Chelmsford,	232	637	1,358	1[1]	3 tuberculosis,[2] 1 septicæmia, 1 emaciation, 1 died otherwise than by slaughter.	26 immature, 1 septicæmia, 1 died otherwise than by slaughter.	4 hog cholera,[2] 1 emaciation, 1 decomposed.	-
Chelsea,	-	-	-	-	-	-	-	-
Cheshire,	43	103	244	-	-	-	-	-
Chester,	18	93	114	19	1 tuberculosis,	-	-	-
Chesterfield,	21	26	146	2	-	-	-	-
Chicopee,	36	47	649	1	1 tuberculosis,	-	5 hog cholera, 2 pneumonia.	-
Chilmark,	12	42	27	20	-	-	-	-
Clarksburg,	109	154	128	-	2 tuberculosis,	-	-	-
Clinton,	138	641	131	-	6 tuberculosis, 1 peritonitis, traumatic.	10 immature, 1 abscess, 2 diarrhœa.	1 jaundice,	-
Cohasset,	5	10	135	-	2 tuberculosis,	-	2 tuberculosis,	-
Colrain,	61	35	298	3	1 injured,	-	-	-
Concord,	2	-	7	-	-	-	-	-
Conway,	34	11	125	12	-	-	-	-
Cummington,	16	39	177	3	1 weak condition,	-	-	-
Dalton,	36	25	137	-	1 tuberculosis,	-	-	-
Dana,	6	3	51	-	-	1 gastritis,	-	-
Danvers,	5	335	-	-	1 tuberculosis,	-	-	-
Dartmouth,	12	22	525	-	-	-	1 advanced pregnancy,	-
Dedham,	8	365	345	1	1 pneumonia, traumatic, 1 injured.	-	2 hog cholera,	-

Deerfield,	50	81	301	9	2 tuberculosis,	1 immature,	1 difficult parturition,	-	-
Dennis,	11	31	108	-	-	-	1 nephritis,	-	-
Dighton,	345	242	45	5	-	-	-	-	-
Douglas,	24	62	39	-	-	-	-	-	-
Dover,	-	-	28	-	-	-	-	-	-
Dracut,	2,151	1,370	892	-	14 tuberculosis, 1 inspector not present.	4 tuberculosis, 24 immature.	1 hog cholera, 2 emaciation,	-	-
Dudley,	227	314	266	-	3 tuberculosis, 1 peritonitis,	-	2 tuberculosis,	-	-
Dunstable,	10	2	5	4	1 tuberculosis,	-	-	-	-
Duxbury,	8	61	179	-	-	-	-	-	-
East Bridgewater,	10	295	40	2[1]	-	-	-	-	-
East Longmeadow,	50	27	195	-	1 tuberculosis,	-	1 tuberculosis,	-	-
Eastham,	2	32	67	-	-	-	-	-	-
Easthampton,	25	719	223	-	1 tuberculosis,	-	-	-	-
Easton,	22	321	24	4	-	-	-	-	-
Edgartown,	12	21	177	41	6 tuberculosis,	-	-	-	-
Egremont,	53	42	101	40	-	-[2]	-	-	-
Enfield,	3	369	93	-	-	-	1 abscess,	-	-
Erving,	3	9	76	-	-	-	-	-	-
Essex,	-	2	35	-	-	-	-	-	-
EVERETT,	-	-	-	-	-	-	-	-	-
Fairhaven,	1,644	1,723	147	9	13 tuberculosis, 2 parturient apoplexy, 2 septicæmia.	6 tuberculosis, 45 immature.	5 tuberculosis,	-	-
FALL RIVER,	-	-	6	-	-	-	-	-	-
Falmouth,	8	161	358	-	-	-	-	-	-

[1] Goat.

[2] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Fitchburg,	888	1,748	465	21	4 tuberculosis, 2 peritonitis.	3 immature, 4 injured, 19 weak condition.	2 hog cholera, 1 injured,	–
Florida,	18	39	44	–	–	–	–	–
Foxborough,	2	7	1	–	–	–	–	–
Framingham,	40	244	60	8	1 tuberculosis,	4 immature,	–	–
Franklin,	3	20	363	–	–[1]	–	–[1]	–
Freetown,	3	16	90	–	–	–	–	–
Gardner,	314	480	209	4	20 tuberculosis, 1 peritonitis, 1 metroperitonitis.	21 immature,	–	–
Gay Head,	–	1	–	–	–	–	–	–
Georgetown,	15	12	34	–	3 tuberculosis,	–	–	–
Gill,	36	70	198	22	–	–	–	–
Gloucester,	40	100	129	4	2 tuberculosis,	2 illegally slaughtered,	–	–
Goshen,	25	58	40	3	1 tuberculosis,	1 septicæmia,	–	–
Gosnold,	–	–	16	–	–	–	–	–
Grafton,	26	256	344	–	1 tuberculosis, 2 septicæmia, 1 injured.	4 immature, 1 bruised, 1 injured, 1 inspector not present.	–	–
Granby,	50	83	118	–	–	–	2 tuberculosis,	–
Granville,	15	35	122	2	–	–	–	–
Great Barrington,	28	191	215	50	1 tuberculosis,	–	1 tuberculosis,	–
Greenfield,	115	193	295	124	6 tuberculosis,	1 immature,	2 tuberculosis,	–
Greenwich,	14	51	57	–	–	–	–	–
Groton,	–	–	79	–	–	–	–	–

Groveland,	-	1	-	-	-	-	-	-	-	-	-	-
Hadley,	46	24	257	-	-	-	-	-	-	-	-	-
Halifax,	-	-	4	-	-	-	-	-	-	-	-	-
Hamilton,	-	1	4	-	-	-	-	-	-	-	-	-
Hampden,	9	163	51	-	1 tuberculosis, . . .		-	-	-	-	-	-
Hancock,	17	31	42	54	-	-	1 tuberculosis, . . .		-	-	-	-
Hanover,	1	37	103	-	-	-	-	-	-	-	-	-
Hanson,	-	2	98	-	-	-[1]	-	-	-	-	-	-
Hardwick,	96	200	220	17	-	-	-	-	-	-	-	-
Harvard,	41	311	261	11	-	-	-	-	-	-	-	-
Harwich,	35	49	208	2	-	-	-	-	1 tuberculosis, . . .		-	-
Hatfield,	30	108	333	-	7 tuberculosis, . . .		-	-	-	-	-	-
HAVERHILL,	-	-	17	-	-	-	-	-	-	-	-	-
Hawley,	11	3	53	10	-	-	-	-	-	-	-	-
Heath,	13	-	77	-	-	-	-	-	-	-	-	-
Hingham,	5	-	184	-	1 tuberculosis, . . .		-	-	1 tuberculosis, . . .		-	-
Hinsdale,	36	85	41	-	7 tuberculosis, . . .		-	-	-	-	-	-
Holbrook,	-	-	1	-	-	-	-	-	-	-	-	-
Holden,	101	311	506	18	-	-	11 immature, . . .		1 tuberculosis, 2 hog cholera.		-	-
Holland,	1	5	29	-	-	-	-	-	-	-	-	-
Holliston,	424	1,512	17	-	12 tuberculosis, . . .		28 immature, . . .		-	-	-	-
HOLYOKE,	1	2	135	-	-	-	-	-	-	-	-	-
Hopedale,	-	-	-	-	-	-	-	-	-	-	-	-

[1] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Hopkinton,	1	19	117	4	– –	– –	1 tuberculosis,	– –
Hubbardston,	8	73	115	–	– –	– –	– –	– –
Hudson,	2	31	70	–	– –	– –	2 hog cholera,	– –
Hull,	–	–	8	–	– –	– –	– –	– –
Huntington,	3	–	43	–	– –	– –	– –	– –
Ipswich,	3	15	133	–	– –	– –	1 poisoning,	– –
Kingston,	2	11	97	–	– –	– –	2 tuberculosis,	– –
Lakeville,	2	4	78	–	– –	– –	– –	– –
Lancaster,	4	2	181	–	– –	– –	– –	– –
Lanesborough,	85	106	291	–	3 tuberculosis,	– –	– –	– –
Lawrence,	83	215	1,159	11	1 tuberculosis,	7 immature,	1 pneumonia, 1 emaciation, 1 paresis, parturient.	– –
Lee,	76	145	189	2	7 tuberculosis, 1 actinomycosis.	1 ulcers of liver, 1 abscess,	1 tuberculosis, 1 ulcers, 3 sexual odor.	– –
Leicester,	29	605	268	–	3 tuberculosis,	– –	– –	– –
Lenox,	341	422	208	27	1 tuberculosis, 1 septicæmia, 1 soiled.	– –	– –	– –
Leominster,	67	379	610	–	2 tuberculosis, 1 pericarditis, traumatic, suppurative.	15 immature,	6 tuberculosis,	– –
Leverett,	47	19	92	1	– –	– –	– –	– –
Lexington,	99	1,349	3,162	16	15 tuberculosis, 1 strangulation, 1 poisoning.	17 immature,	13 hog cholera, 2 emaciation.	– –
Leyden,	65	126	95	2	– –[1]	– –[1]	– –	– –

Lincoln,	29	69	549	-	2 pregnancy,	5 immature,	3 tuberculosis, 11 hog cholera, 5 pneumonia.	-	-
Littleton,	-	-	90	-	-	-	-	-	-
Longmeadow,	5	2	29	-	-	-	-	-	-
LOWELL,	-	-	556	-	-	-	5 tuberculosis, 3 pneumonia, 1 hog cholera, 1 died otherwise than by slaughter.	-	-
Ludlow,	44	1,232	156	-	1 tuberculosis,	2 immature, 2 diarrhœa, 1 died otherwise than by slaughter.	-	-	-
Lunenburg,	490	1,223	761	8	18 tuberculosis, 1 tumor, 2 parturient apoplexy.	35 immature, 1 intestinal obstruction, 4 pneumonia.	-	-	-
LYNN,	63	118	117	-	2 tuberculosis,	8 immature,	3 tuberculosis, 1 hog cholera.	-	-
Lynnfield,	69	388	-	3	4 tuberculosis, 1 cancer,	-	-	-	-
MALDEN,	-	-	-	-	-	-	-	-	-
Manchester,	-	-	-	-	-	-	-	-	-
Mansfield,	24	37	542	-	2 tuberculosis,	-	1 tuberculosis,	-	-
Marblehead,	-	-	76	-	-	-	-	-	-
Marion,	-	4	78	-	-	-	-	-	-
MARLBOROUGH,	11	97	256	-	3 tuberculosis,	5 immature,	2 hog cholera, 1 rheumatism.	-	-
Marshfield,	7	4	137	2	-	-	-	-	-
Mashpee,	2	-	27	-	-	-	-	-	-
Mattapoisett,	2	6	207	5	-	-	-	-	-
Maynard,	23	250	296	1	4 tuberculosis,	8 immature, 1 emaciation, 1 stillborn.	1 tuberculosis, 4 hog cholera.	-	-
Medfield,	9	-	231	-	-	-	2 tuberculosis,	-	-
MEDFORD,	-	-	-	-	-	-	-	-	-
Medway,	6	6	114	-	1 hemorrhage,	-	-	-	-

[1] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Melrose,	-	-	10	-	-	-	-	-
Mendon,	7	13	70	-	-	-	-	-
Merrimac,	27	28	58	-	-	-	-	-
Methuen,	855	455	515	2	21 tuberculosis,	62 immature,	5 tuberculosis,	-
Middleborough,	139	223	305	3	4 tuberculosis,	1 immature,	1 tuberculosis, 1 hog cholera, 1 ulcers, 1 urticaria.	-
Middlefield,	-	2	-	-	-	-	-	-
Middleton,	7	122	6	-	4 tuberculosis,	-	-	-
Milford,	342	752	666	6	3 tuberculosis,	62 immature,	-	-
Millbury,	1	22	93	-	-	-	-	-
Millis,	144	260	145	-	1 tuberculosis,	-	-	-
Millville,	-	-	-	-	-	-	-	-
Milton,	-	-	41	13	-	-	-	-
Monroe,	3	7	21	4	-	-	-	-
Monson,	29	77	158	2	-	-	1 tuberculosis,	-
Montague,	207	379	343	15	1 tuberculosis,	-	-	-
Monterey,	99	236	108	20	1 tuberculosis,	-	-	-
Montgomery,	10	82	18	1	-	-	-	-
Mount Washington,	-	-	-	-	-	-	-	-
Nahant,	-	-	-	-	-	-	-	-

Nantucket, ...	15	90	174	20	13 tuberculosis, . . .		–	–	–	–	–	–
Natick, ...	–	1	1	–	–	–	–	–	–	–	–	–
Needham, ...	–	–	–	–	–	–	–	–	–	–	–	–
New Ashford, . . .	21	11	42	22	1 tuberculosis, . . .		–	–	–	–	–	–
New Bedford, . .	142	354	319	–	8 tuberculosis, . . .		2 immature, . . .		1 tuberculosis, . . .		–	–
New Braintree, . . .	79	553	24	–	–	–	–	–	–	–	–	–
New Marlborough, . .	45	99	189	49	–	–	–	–	–	–	–	–
New Salem, . . .	27	38	68	1	–	–	–	–	–	–	–	–
Newbury, ...	35	354	193	10	7 tuberculosis, . . .		25 immature, . . .		–	–	–	–
Newburyport, . .	456	820	222	1	6 tuberculosis, . . .		6 immature, . . .		1 tuberculosis, 4 hog cholera.		–	–
Newton, ...	–	–	–	–	–	–	–	–	–	–	–	–
Norfolk, ...	16	2	131	–	–	–	–	–	–	–	–	–
North Adams, . .	288	338	342	33	8 tuberculosis, . . .		–	–	–	–	–	–
North Andover, . .	11	173	131	–	–	–	–	–	–	–	–	–
North Attleborough, .	220	270	465	84	5 tuberculosis, 1 septicæmia.		4 immature, . . .		3 tuberculosis, 3 hog cholera.		–	–
North Brookfield, . .	99	361	142	–	2 emaciation, . . .		1 immature, 1 improperly bled.		1 tuberculosis, . . .		–	–
North Reading, . .	34	84	169	–	–	–	–	–	–	–	–	–
Northampton, . .	271	874	349	–	34 tuberculosis, . . .		3 immature, . . .		–	–	–	–
Northborough, . . .	5	35	61	–	–	–	–	–	–	–	–	–
Northbridge, . . .	8	30	88	–	1 tuberculosis, . . .		–	–	–	–	–	–
Northfield, . . .	17	69	116	3	–	–	–	–	–	–	–	–
Norton, ...	143	259	56	–	–	–	–	–	–	–	–	–
Norwell, ...	2	49	432	10	–	–	–	–	1 tuberculosis, . . .		–	–
Norwood, ...	3	10	45	18	–	–	–	–	–	–	–	–

[1] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Oak Bluffs,	-	11	6	-	-	-	-	-
Oakham,	13	32	61	-	-	-	-	-
Orange,	32	48	337	2	-	-	4 tuberculosis,	-
Orleans,	9	11	85	-	-	-	-	-
Otis,	18	54	58	9	-	-	-	-
Oxford,	7	46	264	1	1 tuberculosis,	-	1 tuberculosis,[1]	1 injured.
Palmer,	212	223	302	-	5 tuberculosis,	3 immature,	1 tuberculosis,	-
Paxton,	23	155	44	-	-	-	-	-
Peabody,	641	809	2,153	90	10 tuberculosis,	31 immature,[1]	1 tuberculosis, 44 hog cholera, 1 pneumonia.	2 strangulation, 1 weak condition.
Pelham,	2	5	68	-	-	-	-	-
Pembroke,	11	70	134	6	-	-	-	-
Pepperell,	21	552	544	2	-	4 immature,	-	-
Peru,	10	18	22	-	-	-	-	-
Petersham,	14	46	155	12	-	-	-	-
Phillipston,	26	43	67	4	-	-	-	-
Pittsfield,	600	476	977	65	4 tuberculosis,	7 emaciation,	-	-
Plainfield,	31	59	99	-	-	-	1 tuberculosis,	-
Plainville,	-	-	13	-	-	-	-	-
Plymouth,	44	68	418	15	-	-	-	-

Plympton,	–	–	33	–	–	–	–	–	–
Prescott,	8	1	23	–	–	–	–	–	–
Princeton,	5	1	33	1	–	–	–	–	–
Provincetown,	3	7	161	–	–	–	2 hog cholera,	–	–
QUINCY,	–	–	–	–	–	–	–	–	–
Randolph,	1	1	164	–	–	–	–	–	–
Raynham,	13	87	75	5	–	–	1 hog cholera,	–	–
Reading,	412	343	318	2	3 tuberculosis,	12 immature,	2 tuberculosis, 2 hog cholera, 1 injured.	–	–
Rehoboth,	126	991	130	10	–	1 tuberculosis,	–	–	–
REVERE,	–	–	–	–	–	–	–	–	–
Richmond,	107	152	257	54	1 actinomycosis,	2 immature,	–	–	–
Rochester,	69	573	465	7	3 tuberculosis,	–	3 tuberculosis,	–	–
Rockland,	–	1	–	–	–	–	–	–	–
Rockport,	40	176	19	–	2 tuberculosis,	–	–	–	–
Rowe,	6	7	37	10	–	–	–	–	–
Rowley,	56	226	188	–	2 tuberculosis, 1 bruised,	–	–	–	–
Royalston,	20	59	146	31	–	–	1 hepatitis,	–	–
Russell,	5	12	64	–	–	–	–	–	–
Rutland,	122	211	215	6	–	–	–	–	–
SALEM,	–	–	4	–	–	–	–	–	–
Salisbury,	2	10	166	–	–	–	1 tuberculosis,	–	–
Sandisfield,	121	71	70	4	1 tuberculosis,	–	–	–	–
Sandwich,	1	51	30	–	–	–	–	–	–
Saugus,	1	7	238	–	–	–	8 hog cholera,	–	–

[1] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Savoy,	8	30	89	6	-	-	-	-
Scituate,	9	17	43	-	-	-	-	-
Seekonk,	4	28	158	-	1 tuberculosis,	-	-	-
Sharon,	-	-	12	-	-	-	-	-
Sheffield,	108	74	181	11	1 tuberculosis,	-	-	-
Shelburne,	89	98	202	114	-	-	-	-
Sherborn,	1	9	12	-	-	-	-	-
Shirley,	19	1	184	-	2 tuberculosis, 1 intestinal obstruction.	-	-	-
Shrewsbury,	1,552	1,456	241	1	9 tuberculosis,	31 immature, 2 tuberculosis, 1 bruised, 3 stillborn, 2 died otherwise than by slaughter.	-	-
Shutesbury,	6	2	31	-	-	-	-	-
Somerset,	4	-	314	-	-	-	-	-
SOMERVILLE,	-	-	737	-	-	-	1 hog cholera,	-
South Hadley,	958	2,012	342	2	2 tuberculosis,	6 immature, 2 bruised,	2 hog cholera,	-
Southampton,	77	43	180	3	-	1 immature,	-	-
Southborough,	-	2	-	-	-	-	-	-
Southbridge,	66	92	241	-	1 tuberculosis,	2 immature,	-	-
Southwick,	24	83	163	-	2 tuberculosis, 1 septicæmia.	-	1 tuberculosis,	-
Spencer,	8	79	85	10	-	-	-	-
SPRINGFIELD,	2	12	83	-	-	1 pneumonia,	-	-

Sterling,	71	680	179	2	1 decomposition,	16 immature,	–	–
Stockbridge,	33	58	271	48	–	–	–	–
Stoneham,	–	–	–	–	–	–	–	–
Stoughton,	117	201	182	–	–	1 immature,	–	–
Stow,	1	1	–	–	–	–	–	–
Sturbridge,	251	618	156	11	4 tuberculosis, 2 pneumonia.	10 immature, 4 diarrhœa, 1 died otherwise than by slaughter.	1 tuberculosis,	–
Sudbury,	–	–	95	–	–	–	–	–
Sunderland,	22	48	23	–	–	4 immature,	–	–
Sutton,	36	284	105	–	–	–	–	–
Swampscott,	1	–	4	–	–	–	–	–
Swansea,	436	477	223	25	9 tuberculosis, 1 emaciation,	–	–	1 emaciation.
Taunton,	252	280	1,375	30	10 tuberculosis,	1 tuberculosis,	1 emaciation,	26 nodular disease.
Templeton,	36	168	316	–	–	1 tuberculosis, 3 immature, 1 diarrhœa.	1 tuberculosis,	–
Tewksbury,	378	327	222	1[1]	1 tuberculosis, 1 poisoning,	4 immature,	1 pneumonia,	–
Tisbury,	–	1	10	–	–	–	–	–
Tolland,	11	54	150	–	–	–	–	–
Topsfield,	1	86	148	620	–	2 immature,	–	–
Townsend,	41	61	170	–	3 tuberculosis,	–	–	–
Truro,	–	5	19	–	–	–	–	–
Tyngsborough,	4	–	53	–	–	–	–	–
Tyringham,	3	53	40	–	–	–	–	–
Upton,	40	44	73	157	–	–	–	–
Uxbridge,	21	14	136	–	–	–	1 tuberculosis,	–

[1] Goat.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Continued.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Wakefield,	-	-	804	-	-	-	1 tuberculosis, 4 pneumonia, 10 hog cholera, 1 jaundice.	-
Wales,	5	8	26	-	1 fever,	-	-	-
Walpole,	18	11	786	-	3 tuberculosis, 1 tumor,	-	2 tuberculosis,	-
Waltham,	1	-	121	-	-	-	-	-
Ware,	5	11	124	-	-	-	2 tuberculosis,	-
Wareham,	12	22	350	-	2 tuberculosis, 1 carcinoma,	-	-	-
Warren,	25	71	245	1	3 tuberculosis,	-	1 tuberculosis,	-
Warwick,	9	8	55	-	-	-	-	-
Washington,	36	39	42	-	1 tuberculosis,	-	-	-
Watertown,	405	11,769	82	60	13 tuberculosis, 1 jaundice, 1 bruised, 1 abscess, 1 tumor, 11 died otherwise than by slaughter.	631 immature, 1 tuberculosis, 2 died otherwise than by slaughter.	-	1 emaciation.
Wayland,	-	4	73	-	-	-	3 tuberculosis,	-
Webster,	3	18	156	-	-	-	2 tuberculosis, 8 hog cholera.	-
Wellesley,	-	-	-	-	-	-	-	-
Wellfleet,	9	15	80	1	-	-	-	-
Wendell,	11	24	54	5	-	-	-	-
Wenham,	549	606	221	2[1]	10 tuberculosis,	14 immature,	-	-
West Boylston,	6	18	54	4	-	-	-	-
West Bridgewater,	14	798	807	1	3 tuberculosis, 2 pneumonia, 1 bruised.	18 immature,	1 tuberculosis,	-

West Brookfield,	13	35	89	10	–	–	1 hog cholera,	–	–
West Newbury,	84	62	195	–	2 tuberculosis,	–	1 tuberculosis,	–	–
West Springfield,	26	163	197	20	–	–	1 pneumonia,	–	–
West Stockbridge,	28	46	120	16	–	–	1 metritis,	–	–
West Tisbury,	15	34	18	252	1 tuberculosis,	–	–	–	–
Westborough,	12	24	168	–	1 fever,	–	2 tuberculosis,	–	–
Westfield,	140	177	255	–	1 tuberculosis, 1 parturient apoplexy.	–	–[2]	–	–
Westford,	14	450	487	2	–	2 immature,	4 hog cholera,	–	–
Westhampton,	41	60	89	–	–	–	–	–	–
Westminster,	70	159	258	1	1 tuberculosis,	2 immature,	–	–	–
Weston,	52	154	218	17	–	12 immature,	–	–	–
Westport,	1,176	2,243	1,040	64	1 tuberculosis,	2 immature, 1 strangulation, 1 bruised.	7 hog cholera,	–	–
Westwood,	30	816	681	3	–	–	1 tuberculosis, 1 septicæmia, 1 emaciation.	–	–
Weymouth,	10	426	333	–	2 tuberculosis, 1 bruised,	35 immature, 5 bruised,	1 pneumonia,	–	–
Whately,	138	122	58	5	4 tuberculosis,	–	–	–	–
Whitman,	–	–	–	–	–	–	–	–	–
Wilbraham,	6	22	157	–	–	–	–[2]	–	–
Williamsburg,	19	20	147	–	3 tuberculosis,	–	–	–	–
Williamstown,	52	504	474	35	5 tuberculosis, 1 mastitis, suppurative, 1 pyæmia, 1 injured, 1 pericarditis, traumatic.	11 immature,	–	–	–
Wilmington,	–	–	762	–	–	–	20 hog cholera, 1 injured,	–	–
Winchendon,	54	82	362	1	5 tuberculosis,	1 immature,	–[2]	–	–
Winchester,	–	–	–	–	–	–	–	–	–

[1] And one goat.

[2] Certain organs or parts condemned.

Report on Inspection of Slaughtering for the Year ending Sept. 30, 1917 — Concluded.

City or Town.	Inspected.				Condemned.			
	Cattle.	Calves.	Hogs.	Sheep.	Cattle.	Calves.	Hogs.	Sheep.
Windsor,	31	130	145	13	-	-	-	-
Winthrop,	-	-	-	-	-	-	-	-
Woburn,	42	1,073	3,712	7	-	49 immature, 3 inspector not present.	3 tuberculosis, 19 pneumonia, 1 lacerated.	-
Worcester,	1,058	1,323	1,569	14	16 tuberculosis, 1 emaciation, 1 anæmia.	22 immature,	3 pneumonia, 2 hog cholera, 1 emaciation.	-
Worthington,	22	41	139	4	-	-	-	-
Wrentham,	2	2	37	-	-	-	-	-
Yarmouth,	1	1	70	-	-	-	-	-

Summary.

Cities and towns failing to report —

For one quarter,	30
For two quarters,	8
For three quarters,	3
No report,	1

Total number of carcasses inspected,		197,070
Cattle,	30,554	
Calves,	90,663	
Hogs,	72,846	
Sheep,	2,999	
Goats,	8	
Total number of carcasses condemned,		3,128
Cattle,	637	
Calves,	2,066	
Hogs,	393	
Sheep,	32	
Total number of carcasses passed,		193,942

Reasons for Condemnation.	Cattle.	Calves.	Hogs.	Sheep.	Totals.
Immaturity,	-	1,877	-	-	1,877
Tuberculosis,	551	18	120	-	689
Actinomycosis,	2	-	-	-	2
Pneumonia,	4	1	47	-	52
Pneumonia, traumatic,	1	-	-	-	1
Hog cholera,	-	-	179	-	179
Gastritis,	-	1	-	-	1
Indigestion,	1	-	-	-	1
Tetanus,	1	-	-	-	1
Enteritis,	-	-	1	-	1
Nephritis,	-	1	1	-	2
Intestinal obstruction,	1	1	-	-	2
Nodular disease,	-	-	-	26	26
Peritonitis,	4	-	-	-	4
Peritonitis, traumatic,	1	-	-	-	1
Metroperitonitis,	1	-	-	-	1
Ulcers of liver,	-	1	-	-	1
Hepatitis,	-	-	1	-	1
Jaundice,	1	4	3	-	8
Urticaria,	-	-	7	-	7
Diarrhœa,	-	9	-	-	9
Dysentery,	-	1	-	-	1
Abscesses,	3	2	2	-	7
Umbilical abscesses,	-	2	-	-	2
Tumors,	4	-	1	-	5
Cancer,	1	-	-	-	1
Carcinoma,	1	-	-	-	1
Ulcers,	-	-	2	-	2
Mastitis, suppurative,	1	-	-	-	1
Hemorrhage,	1	-	-	-	1

Reasons for Condemnation.	Cattle.	Calves.	Hogs.	Sheep.	Totals.
Septicæmia,	9	3	2	–	14
Pyæmia,	1	–	2	–	3
Phlebitis,	–	3	–	–	3
Polyarthritis,	–	2	–	–	2
Rheumatism,	–	–	1	–	1
Paralysis,	2	–	–	–	2
Pericarditis, traumatic,	1	–	–	–	1
Pericarditis, traumatic, suppurative,	1	–	–	–	1
Fever,	2	–	–	–	2
Pregnancy,	2	–	–	–	2
Advanced pregnancy,	1	–	1	–	2
Parturient apoplexy,	5	–	–	–	5
Metritis,	–	–	1	–	1
Parturient paresis,	–	–	1	–	1
Difficult parturition,	–	–	1	–	1
Stillborn,	–	4	–	–	4
Emaciation,	5	14	9	2	30
Anæmia,	3	–	–	–	3
Weak condition,	1	65	–	1	67
Sexual odor,	–	–	3	–	3
Poisoned,	2	–	1	–	3
Lacerated,	–	–	1	–	1
Wounded,	1	–	–	–	1
Bruised,	4	35	–	–	39
Injured,	5	7	3	1	16
Strangulation,	2	1	–	2	5
Soiled,	1	–	–	–	1
Improperly bled,	–	1	–	–	1
Inspector not present,	1	4	–	–	5
Illegally slaughtered,	–	2	–	–	2
Decomposition,	1	–	2	–	3
Died otherwise than by slaughter,	8	7	1	–	16
Totals,	637	2,066	393	32	3,128

Division of Communicable Diseases.

DIVISION OF COMMUNICABLE DISEASES.

Report of the Work of the Bacteriological Laboratory of the State Department of Health for the Year ended Nov. 30, 1917.

During the year ended Nov. 30, 1917, 22,480 specimens for examination were received at the Diagnostic Laboratory. This number represents an increase of 340 over the number for the previous year. The following table shows the scope of the work: —

	Results of Examinations.		
	Positive.	Negative.	Total.
Diphtheria,	2,636	11,353	13,989
Tuberculosis,	831	2,899	3,730
Typhoid fever: —			
Widal test,[1]	456	1,407	1,970
Culture test,	45	673	718
Malaria,	2	82	84
Gonorrhœa,	132	1,080	1,212
Miscellaneous,	-	-	777
Totals,	-	-	22,480

[1] Atypical, 107.

A smaller number of cultures was examined for diphtheria bacilli than for the year 1916. This was principally due to the fact that fewer school cultures were examined than usual. There were fewer specimens of blood tested for the Widal reaction than last year. All other branches of the work increased, the most notable increase being in typhoid culture work, which was more than doubled.

A new diagnosis was started the latter part of the year, — that of the determination of pneumococcus types in sputa. This work has been limited to the examination of specimens for a few selected hospitals.

Diphtheria Examinations.

There were 13,989 cultures received for examination for diphtheria bacilli. The results are tabulated below: —

	Results of Examinations.		
	Positive.	Negative.	Total.
Diagnosis,	1,332	7,811	9,143
Release,	1,304	3,542	4,846
Totals,	2,636	11,353	13,989

Examinations for Tuberculosis.

There has been a decided increase in the number of specimens of sputa examined for tubercle bacilli; over 600 more were sent this year than last. The percentage of positives was a trifle lower than for last year.

Positive,	831
Negative,	2,899
Total,	3,730

Typhoid Fever Examinations.

Widal Test.

There have been 1,970 specimens of blood examined for the Widal reaction for typhoid fever. The results follow: —

Positive,	456
Negative,	1,407
Atypical,	107
Total,	1,970

Culture Test.

The number of examinations of specimens of blood, feces and urine for the presence of the typhoid bacillus has more than doubled this year, 718 specimens being examined. The number of individuals represented was 401. The distribution was as follows: —

Blood,	37
Urine,	189
Feces,	490
Pus,	1
Duodenal contents,	1

Persons sick,	86
Convalescent,	240
Suspected carriers,	75

The typhoid bacillus was isolated 45 times, once each from blood and pus, five times from urine, and 39 times from feces. Eight carriers were discovered, two of whom were milk handlers. The others were not responsible for any epidemics of typhoid fever, but were suspected on account of cases in their households.

The specimens are sent to the laboratory in a tube provided for the purpose containing 30 per cent glycerine in physiological salt solution. When they reach the laboratory they are streaked on a series of Endo plates. Suitable colonies are fished, inoculated into broth, tested with typhoid sera and confirmatory tests made in sugar broths.

Examinations for Malaria.

Malarial parasites were found in 2 of the 84 specimens of blood sent for examination.

Examinations for Gonorrhœa.

There were 1,212 smears sent to the laboratory to be examined for gonococci; the majority of smears were taken as a precautionary measure by the State Board of Charity.

Positive,	132
Negative,	1,080
Total,	1,212

Examinations for Pneumonia.

The determination of pneumococcus types in sputa has been carried on for the last two months of the year, 63 specimens being received during that time. The technique used is that taught at the Rockefeller Hospital. In all instances both agglutination and precipitin tests are carried out, and with the majority of specimens of types I. and II. both reactions are shown. The following distribution of types was obtained: —

Type I.,	3
Type II.,	21
Type III.,	4
Type IV.,	29
Unsatisfactory,	6
Total,	63

An unusually high percentage of pneumococci of Type II. was obtained as compared with Type I. These findings may be due to the fact that the majority of Type II. cases lived in one locality.

Miscellaneous Examinations.

Miscellaneous examinations totaling 777 were made. These included examinations of blood for the Widal reaction for paratyphoid fever, feces for dysentery bacilli, diphtheria cultures for virulence, spinal fluids for meningococci and other organisms, pus for anthrax bacilli, urine and other fluids for tubercle bacilli, and throat cultures for hemolytic streptococci.

Methods of reporting Results.

This year we have reported by telephone, at the expense of this department, positive diphtheria cultures for diagnosis. Heretofore they have been telephoned collect when requested. All negative and release cultures for diphtheria and all other diagnoses are telephoned only at the request of the physician or board of health, and toll charges are to be paid by them. In every case a written report is sent to the physician. If diagnoses are positive, a report is sent to the local board of health also. Boards of health receive upon request duplicate reports of negative examinations.

Report of the Epidemiologist for the Year ending Nov. 30, 1917.

During the year additional information has been sought regarding cases of communicable disease reported to the Department by local boards of health through adding to the post cards supplied them for this purpose columns for recording the age and sex of each case.

Several new methods have been instituted for obtaining more complete morbidity records and additional epidemiological information for aiding in the diagnosis and treatment of disease, and for disseminating information as to the prevalence of epidemic diseases, as specified below: —

1. Preparing individual case records for smallpox, epidemic cerebrospinal meningitis, anthrax, and diseases on the premises of milk handlers; also a similar, duplicate case record for typhoid fever cases, the duplicate to be retained by the investigator.
2. Making a record for reference purposes of all known typhoid bacillus carriers, also a list of all suspected carriers for the present year.
3. Establishing a pin map system in the central office for smallpox, epidemic cerebrospinal meningitis, anterior poliomyelitis, malaria and typhoid fever, showing the cases by months.
4. Making efforts to locate meningococcus carriers.
5. Keeping a supply of anthrax serum on hand for the treatment of cases, and obtaining cultures from all cases treated with the serum, in order to confirm the diagnosis by animal tests.
6. Establishing a system of interstate reciprocal notification and furnishing monthly tables of such cases to the United States Public Health Service.
7. Checking up all laboratory findings of typhoid fever, tuberculosis and diphtheria with the cases reported, for the purpose of detecting unreported cases and obtaining reports for them.

To secure more prompt and complete epidemiological information throughout the State, an "outbreak" notice was devised. The form contains the name of the city or town concerned, the name of the disease present, the number of cases reported for the preceding month, the current month by days, and for the corresponding months of the

previous year, and the endemic index for the same months. Whenever the daily reports from local boards of health suggest the undue presence of disease, this blank is sent to the District Health Officer, who makes report upon a form, giving a history of the outbreak, the number of cases, and any recommendations made.

Typhoid Bacillus Carriers.

During the last half of the year special efforts were made to locate all known typhoid carriers, to ascertain quarterly any change of address, and to be sure that they are not engaged in the handling of food. Carriers have been found as follows: —

Year.	Number.	Year.	Number.
1910,	2	1915,	5
1912,	1	1916,	8
1913,	2	1917,	10

In addition to the 10 known carriers found in 1917, examinations were carried out in 15 individuals, suspected of being carriers, responsible for groups of cases or family outbreaks. These examinations were negative, though not conclusive, since it is well recognized that typhoid bacilli are not constantly eliminated by the carrier, the organism being found usually in but one of three or four specimens.

Practically all initial specimens taken in the field were obtained through personal visits of the District Health Officers.

During the year 10 carriers were found in various sections of the State. Of these, 9 were fecal carriers and 1 was an urinary carrier.

The tabular review below gives the history of these cases as far as known (Widal tests were positive except as noted): —

Locality.	Sex.	Occupation.	Type of Carrier.	Cases infected.	Remarks.
Boston, . .	Male, . . .	Laborer, . .	Urinary; B. typhosus isolated monthly September to November.	2	Had typhoid in June, 1917; infected two roommates in October.
Quincy, . .	Male, . . .	Laborer, . .	Fecal; B. typhosus isolated monthly August to December.	None.	Had typhoid in July; in hospital July to December.
Avon, . . .	Female, . .	Housewife, . .	Fecal; B. typhosus isolated December 4.	1	Had typhoid in 1913, and husband had typhoid in December, 1917.
Marshfield, . .	Male, . . .	Milk handler, .	Fecal; B. typhosus isolated October 29.	4	Stated he never had typhoid; handled milk delivered to six families in which 4 cases of typhoid occurred during the summer of 1917.
Westfield, . .	Male, . . .	School boy, .	Fecal; B. typhosus isolated September 27.	1	Had typhoid in April, 1917; father sick in August, 1917.
Beverly, . .	Female, . .	Cook, . . .	Fecal; B. typhosus isolated September, 1917.	6	Five cases of typhoid occurred in 1916 and one in 1917 among boarders at her house; stated she never had typhoid. Widal was atypical.
Gardner, . .	Male, . . .	Milk handler, .	Fecal; B. typhosus isolated April 27.	85	Denied ever having typhoid fever. Widal is negative. There were 3 cases in 1915, 2 cases in 1916 and 80 cases in 1917 on milk routes supplied by milk from his farm (see special report).
Sherborn, . .	Female, . .	Nurse, . .	Fecal; B. typhosus isolated February 12.	1	Never had typhoid; nursed a typhoid patient in September, 1916, and infected a case in February, 1917.
Bridgewater, .	Male, . . .	- -	Fecal; B. typhosus isolated January 27.	4	Had typhoid in October, 1915; cases occurred in his household in 1916 and 1917.
Mansfield, . .	Female, . .	Housewife, . .	Fecal; B. typhosus isolated February, 1917.	-	Had typhoid in 1915; no cases were ever definitely chargeable to her.

The 10 carriers caused 92 typhoid fever cases in 1917, 9 in 1916 and 3 in 1915.

Diseases on the Premises of Milk Handlers.

Effort was made during the year to obtain reports of cases of disease among milk handlers or their families in order to prevent outbreaks of milk-borne diseases.

The accompanying table shows the number of cases of communicable disease found on the premises of milk handlers. It is of interest to note that there was no known milk-borne diphtheria or typhoid fever from clinical cases of those diseases.

Months.	Diphtheria.	Measles.	Acute Polio-myelitis.	Scarlet Fever.	Septic Sore Throat.	Smallpox.	Typhoid fever.	Totals.
January,	1	–	–	–	–	–	1	2
February,	12	–	–	3	3	1	1	20
March,	–	–	–	–	–	–	–	–
April,	1	–	–	3	3	–	–	7
May,	8	2	–	2	5	–	–	17
June,	–	–	–	2	–	–	–	2
July,	1	–	–	3	2	–	1	7
August,	2	–	–	–	5	–	2	9
September,	1	–	–	–	–	–	3	4
October,	–	–	–	4	–	–	–	4
November,	2	–	1	1	–	–	–	4
December,	–	–	–	5	–	–	2	7
Totals,	28	2	1	23	18	1	10	83

Further, 2 typhoid bacillus carriers were found on farms in Gardner and Marshfield, and also 2 diphtheria bacilli carriers on a farm in Needham.

Outbreaks and Epidemics in the State in 1917.

Two hundred and three outbreaks and epidemics were investigated during the year. In addition, the District Health Officers were called to assist in determining the diagnosis of individual cases in at least 200 instances.

A summary of the more important investigations is given in the following pages: —

Actinomycosis.

Four cases of this disease have been reported during the year, — 1 each from Cambridge, Boston, Danvers and Westwood.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	3	3	.08	.08
1914, ...	3,641,553	4	2	.11	.06
1915, ...	3,706,931	8	4	.22	.11
1916, ...	3,779,033	4	–	.11	–
1917, ...	3,849,006	4	3	.10	.08

Anthrax.

Anthrax again has increased as compared with the previous year; 54 cases were reported. The results of detailed investigations are given in a special report.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	8	3	.22	.08
1914, ...	3,641,553	8	1	.22	.03
1915, ...	3,706,931	11	4	.30	.11
1916, ...	3,779,033	31	5	.82	.13
1917, ...	3,849,006	54	11	1.40	.29

Acute Poliomyelitis.

Anterior poliomyelitis was reported from all parts of the State. Cases were well distributed except in Haverhill, where 38 cases were reported from June to September. The disease has prevailed constantly in Haverhill for the past few years to a greater extent than in some other communities of the same size or larger.

City.	Population.[1]	Cases.					
		1917.	1916.	1915.	1914.	1913.	1912.
Haverhill,	51,806	40	12	6	15	21	3
Malden,	50,897	3	46	–	1	6	1
Holyoke,	62,179	–	116	–	–	–	1
Brockton,	64,668	5	3	6	2	21	1
Somerville,	91,102	3	48	5	5	5	4
Lawrence,	92,187	3	7	2	3	21	–
Lynn,	98,659	11	44	1	3	3	1

[1] Population estimated as of July 1, 1917.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	361	69	10.1	1.9
1914,	3,641,553	151	45	4.1	1.2
1915,	3,706,931	135	32	3.6	0.8
1916,	3,779,033	1,927	452	51.0	12.0
1917,	3,849,006	174	51	4.5	1.3

Chicken Pox.

Ordinarily but little attention is paid to this disease. Often no physician is called and the case is not reported. As a result knowledge of its occurrence is incomplete. An increase of 2,538 cases as compared with the preceding year leads to the belief that the disease is being reported more fully.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	3,822	2	106.9	.06
1914,	3,641,553	4,896	3	134.4	.08
1915,	3,706,931	5,512	5	149.0	.13
1916,	3,779,033	4,672	5	123.6	.13
1917,	3,849,006	7,210	20	187.3	.52

Diphtheria.

With one or two exceptions noted elsewhere, diphtheria did not prevail in epidemic form, though present in greater amount than last year. Accounts follow of some of the 78 outbreaks investigated in detail.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	6,741	628	188.5	17.6
1914, ...	3,641,553	8,080	652	221.9	17.9
1915, ...	3,706,931	9,282	721	250.4	19.4
1916, ...	3,779,033	7,282	629	192.7	16.6
1917, ...	3,849,006	10,322	838	268.2	21.8

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January, . . .	Billerica, . .	7	Contact, . .	Five cases in one family, no physician.
January and February.	Webster, . .	37	Carrier; contact; lack of medical care.	A nurse who had been ill with diphtheria, after two negative cultures returned to her home in Webster; a member of the family and others in the neighborhood shortly developed diphtheria. In one school, to which January cases were largely limited, carriers were found, also pupils at home, ill with diphtheria, with no physician in attendance. In February, 4 cases in one family; no physician till fourth child was dying; 13 other cases infected from this source.
January to March, .	Gardner, . .	87	School contact; bubbler faucet; lack of medical care.	Affected chiefly foreign children in single parochial school, where children's mouths came in contact with a bubbler faucet. Quarantine rules and precautions frequently ignored. Parents objected to immunization and occasionally to the use of antitoxin.
January to April, .	Lowell, . . .	314	Contact, . .	Many cases among the Greek population.
January to April, .	Fitchburg, . .	51	Contact, . .	- -
January to June, .	Cambridge, . .	327	Contact; unrecognized cases.	Careless isolation in families and unrecognized cases.
February, . . .	Leominster, .	16	School contact, .	School outbreak, confined to one locality; nasal type of disease.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
February to April, .	Shirley, . .	12	Contact, . .	State Industrial School; first cases found through the taking of routine cultures on admission of inmates.
March, . . .	Haverhill, . .	46	School contact; unrecognized cases.	Sixteen cases reported in February; 46 in March and 17 in April; unrecognized cases found in school; cultures of 176 pupils were taken, 14 were positive.
March to May, . .	Agawam, . .	9	School contact, .	All cases pupils in one school or in families of pupils.
March to April, .	West Springfield, .	11	School contact, .	Carrier found when school cultures were taken.
March to May, . .	Watertown, . .	35	Contact, . .	Infection from 2 cases ill two weeks before a physician was called.
March and April, .	Everett, . .	37	Contact, . .	Four cases and 1 carrier were found in a private school with 10 pupils.
April and May, .	Revere, . .	27	Contact, . .	- -
April to June, . .	Malden, . .	76	School contact, .	3 carriers found among 217 pupils.
April to July, . .	Chelsea, . .	47	- -	Scattered cases.
May and June, . .	Whitman, . .	15	Contact; lack of quarantine.	First case regarded as tonsillitis; no precautions taken, no physician called till 2 more cases in family.
August and September.	Winchendon, .	14	Contact, . .	Cases largely in foreign population; several instances where no physician called till second case in family.
August to November,	Gardner, . .	140	School contact, .	Cases again largely in foreign district of the town. A school nurse employed in November found 12 absentees ill with diphtheria.
August to November,	Springfield, . .	186	Contact, . .	- -
August and September.	Melrose, . .	41	School contact, .	Cases in August and early September, chiefly in one school. Several carriers, including 1 nasal carrier, were found; 2 carriers were found in the same school when 9 cases of of diphtheria occurred.
September and October.	Fitchburg, . .	41	Contact, . .	Outbreak started from a household where there were 5 cases before a physician was called.
September and October.	Everett, . .	39	Contact, . .	Confined largely to one ward; 10 pupils and a teacher ill in one school; no carriers found.
September and October.	Erving, . .	22	School contact, .	Ten cases in one school; cultures taken, suspects isolated.
September to November.	Malden, . .	65	School contact; lack of medical care.	Outbreak began with 3 cases in one household without medical attendance. Cultures taken from school gave 3 positives out of 50 in one schoolroom and 6 positives out of 62 in another.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
October, . . .	Weston, . .	7	Carrier, . .	Cases in one school. A chronic nasal carrier found who had diphtheria a year before; later a half decayed cherry stone was removed from the carrier's nostril; his subsequent cultures were negative.
October, . . .	Easthampton, .	12	Contact, . .	- -
October, . . .	Holyoke, . .	30	School contact, .	Twenty-three cases in one school; 2 series of cultures taken on successive days were negative; in a third series on the following day 4 healthy carriers were found. In an adjoining school 5 additional carriers were found on taking a third series of cultures.
October and November.	Lowell, . . .	119	Contact, . .	During the outbreak a child was admitted to a hospital from a home in which diphtheria was reported two days later; subsequently 7 nurses and employees developed the disease.
October and November.	North Attleborough.	51	School contact, .	Disease spread from Attleboro, many cases of mild nasal type, recognized only through cultures.
October and November.	West Springfield, .	21	School contact, .	Largely in single school; mild type.
October and November.	Greenfield, . .	16	School contact, .	Six pupils with positive throat cultures were found.
October, . . .	Randolph, . .	14	School contact, .	Outbreak followed release of a diphtheria patient after one negative culture; of cultures from pupils, 3 were positive.
October and November.	Great Barrington,	21	School contact, .	Cases all in one school; 3 carriers found.
October to December.	Boston, . .	1,186	School contact, .	Cases confined largely to two sections of the city; carriers in schools sought and isolated.
October to December,	Amesbury, . .	91	School contact, .	Cases limited to one parochial and two public schools.
October to December,	Chelsea, . .	73	- -	- -
December, . .	Brockton, . .	23	School contact, .	Twenty-one cases in one school district; 12 carriers found among 442 pupils.
December, . .	Attleboro, . .	12	School contact, .	Limited to one school and its immediate neighborhood.
December, . .	Haverhill, . .	26	Contact, . .	Two carriers found in the ward to which cases were limited.
December, . .	Lee, . . .	5	Contact; unreported cases.	Some cases of nasal type. There were in addition many mild unreported cases, without medical attendance.

Dog Bite.

There were 169 cases of "dog bite" brought to the attention of the Department, 60 of which were officially reported. Of these, only 26 were bitten by rabid dogs. Six of the persons bitten were treated by the Department with virus from the hygienic laboratory of the United States Public Health Service; the other 20 were treated by physicians with virus from the New York City board of health.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915,	3,706,931	174	5	4.7	.14
1916,	3,779,033	24	-	.6	-
1917,	3,849,006	26	-	.6	-

Dysentery.

Unless the diagnosis of dysentery is confirmed bacteriologically, there is ground for questioning the accuracy of individual reports. Outbreaks of what appeared to be true dysentery occurred in five localities, though in none of them were specimens obtained early enough to permit of bacteriological diagnosis.

One outbreak, at the State hospital at Medfield, was especially virulent, over 50 per cent. of the cases terminating fatally.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915,	3,706,931	238	92	6.5	2.4
1916,	3,779,033	119	83	3 1	2.2
1917,	3,849,006	160	64	4.2	1.7

Epidemic Cerebrospinal Meningitis.

Aside from cases in Springfield (16) and Pittsfield (8) there was no unusual prevalence of this disease during 1917.

Diagnosis was confirmed bacteriologically in 21 out of 23 individuals where lumbar puncture was recorded.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	180	147	5.0	4.1
1914, ...	3,641,553	181	156	5.0	4.3
1915, ...	3,706,931	145	125	3.9	3.4
1916, ...	3,779,033	150	136	4.0	3.6
1917, ...	3,849,006	196	158	5.1	4.1

Food Poisoning.

The Department has co-operated with the Department of Preventive Medicine and Hygiene of the Harvard Medical School in investigating cases of food poisoning. Five such outbreaks have been studied during the year, without however yielding any information as to their cause.

German Measles.

German measles became epidemic in the State during March, April, May and June, developing especially in the vicinity of Springfield, Boston and New Bedford. The record since German measles was made reportable follows: —

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915, ...	3,706,931	500	1	13.5	.03
1916, ...	3,779,033	591	1	15.6	.03
1917, ...	3,849,006	5,890	5	153.0	.13

Human Glanders.

Two cases were reported. In one instance a woman with a general pustular rash was admitted to a hospital with a diagnosis of rheumatism and erythema. Later some of the pustules yielded a pure culture of the glanders bacillus. Fatal termination. Source of infection not determined.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	3	2	.08	.06
1914,	3,641,553	3	3	.08	.08
1915,	3,706,931	2	1	.06	.03
1916,	3,779,033	–	–	–	–
1917,	3,849,006	2	1	.05	.025

Hook Worm.

For the first time in Massachusetts, hook worm was reported, a single case, by a Chinese physician. An inspector, however, was unable to locate the patient or to secure any information concerning him.

Leprosy.

Three cases were reported during the year, — 1 from Springfield, 1 from Boston and 1 from Gosnold, — all of which were transferred to the leper colony at Penikese.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	2	1	.06	.03
1914,	3,641,553	1	1	.03	.03
1915,	3,706,931	2	1	.05	.03
1916,	3,779,033	2	2	.05	.05
1917,	3,849,006	3	1	.08	.025

Malaria.

There were 78 cases of malaria reported during the year, as follows: —

Month.	Cases.	Month.	Cases.
January,	1	July,	11
February,	2	August,	13
March,	5	September,	12
April,	2	October,	7
May,	5	November,	2
June,	16	December,	2

But 5 of these cases were reported in the Blackstone River valley, which is recognized as one of the State's chief malarial districts. In few instances only is the diagnosis based on the microscopical examination of blood smears, though such examination is much to be desired in all cases.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915,	3,706,931	112	6	3.0	.16
1916,	3,779,033	97	4	2.6	.11
1917,	3,849,006	78	5	2.0	.13

Measles.

Measles prevailed throughout the State with the exception of southern Worcester County, though the number of cases was somewhat less than during 1916. Forty-two outbreaks were investigated in detail, some of which are tabulated below: —

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	29,192	315	816.3	8.8
1914,	3,641,553	12,264	149	336.8	4.1
1915,	3,706,931	22,881	149	617.2	4.0
1916,	3,779,033	25,460	392	673.7	10.4
1917,	3,849,006	23,880	371	620.4	9.7

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January,	Sunderland,	16	Contact,	Seventy-four additional unreported cases, in most instances no physician in attendance.
January,	Hingham,	48	Contact,	Limited largely to Italian families in one section.
January and February.	Rowley,	26	School contact,	All cases in one school.
January and February.	Princeton,	36	School contact,	All cases attended same school; first case not promptly recognized.
January to March,	Melrose,	201	Contact,	- -
January and February.	Deerfield,	55	Contact,	At least 100 additional cases, without medical attendance, unreported.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January to May,	Lexington,	220	Contact,	- -
January to April,	Framingham,	150	Contact,	Many cases unreported, discovered when children applied for permits to return to school.
January to May,	Medford,	326	School contact,	- -
January to June,	Fall River,	1,573	School contact,	Many children found in school ill with measles. Often physician called for initial case, not called for subsequent cases in family. Such children often returned to school in infective stage. Instances occurred where children alleged to be immune by reason of previous attack, developed measles in school.
January to June,	Newton,	522	School contact,	- -
February,	Milton,	74	School contact,	All cases in one school or families represented in the school.
February and March,	Merrimac,	136	Contact,	First outbreak in town for many years.
February to May,	Newburyport,	297	Contact,	- -
March,	Buckland,	26	Contact,	- -
March,	Shelburne,	20	Contact,	- -
March to May,	Williamstown,	39	Contact,	Largely Williams College students.
April,	Pittsfield,	479	School contact,	- -
April to July,	North Adams,	415	Contact,	Infection spread through a church supper.
April to June,	Dalton,	97	School contact,	- -
April to June,	Scituate,	132	School contact,	- -
May to June,	Colrain,	70	Contact,	- -
May to July,	Waltham,	219	School contact,	- -
June and July,	Westminster,	88	Contact,	Many cases without medical care.
May and June,	Athol,	138	Contact,	Unreported and unisolated cases.
September to December.	Westfield,	611	Contact,	Infection introduced apparently with the establishing of a military camp in the town.
October,	Mattapoisett,	35	School contact,	Initial case not promptly recognized.
October to December,	Salem,	179	Contact,	Many cases located by school nurse when making routine home visits.
October to December,	Chelsea,	134	School contact,	- -
October and November.	Holyoke,	287	Contact,	- -
November,	Chesterfield,	40	School contact,	First case a girl returned from a visit in Boston.
November and December.	Somerville,	128	Contact,	- -
December,	Blandford,	34	Contact,	First case recently returned from Westfield, where measles was prevalent.

Mumps.

Made reportable in 1915, mumps was reported very incompletely the first two years. During 1917 there were 7,125 cases. In the early part of the year an unusual prevalence of the disease was noted in Tisbury and Framingham, with 85 and 321 cases, respectively.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915,	3,706,931	2,128	1	57.4	.03
1916,	3,779,033	2,318	3	61.3	.08
1917,	3,849,006	7,125	5	185.1	.13

Ophthalmia Neonatorum.

There were 2,325 cases of infectious diseases of the eye reported, 307 of which were given as suppurative conjunctivitis. Of the latter, 50 were cases of pink eye in Lynn school children.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	2,304	5	64.4	.14
1914,	3,641,553	2,620	–	72.0	–
1915,	3,706,931	2,894	–	78.1	–
1916,	3,779,033	1,932	–	51.1	–
1917,	3,849,006	2,325	3	60.4	.08

Pellagra.

This disease also was made reportable in 1915. Fewer cases were reported during the past year than in either of the two previous years. Twelve of the 28 cases were in State institutions.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915,	3,706,931	33	26	.9	.7
1916,	3,779,033	47	37	1.2	1.0
1917,	3,849,006	28	20	.8	.5

Pneumonia.

This disease was made reportable on May 1, 1917. The largest number of cases reported for any one month was 460 in December.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1917, ...	3,849,006	1,756[1]	4,028[2]	45.6[3]	104.7

[1] Reported since May 1.
[2] For the entire year.
[3] Based on cases reported, obviously incorrect. Inserted for comparison in subsequent years.

Scarlet Fever.

There was no unusual prevalence of scarlet fever except in Berkshire County and in the Connecticut valley. Twenty-three cases were reported among milk handlers or their households. But 8 instances were found, however, where milk served as the vehicle of infection. Thirty-eight outbreaks were investigated, a number of which are tabulated below: —

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	8,062	293	225.4	8.2
1914, ...	3,641,553	11,057	246	303.7	6.8
1915, ...	3,706,931	8,613	182	232.3	4.9
1916, ...	3,779,033	6,271	127	166.0	3.4
1917, ...	3,849,006	5,953	120	154.7	3.1

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January, . . .	Wellesley, . .	12	School contact, .	Cases in one school; first case a pupil returning after the holidays.
January, . . .	Springfield, . .	43	Contact, . .	- -
January and February.	Malden, . .	26	Contact; milk, .	Three cases infected through milk.
January to March, .	Westfield, . .	51	Contact, . .	Many cases among foreign population.
January to March, .	Montague, . .	36	Contact; lack of medical care.	Cases chiefly in foreign families; quarantine poorly observed, in many instances no physician called.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January to July, .	Greenfield, . .	67	Contact, . .	Infection introduced from Montague.
January to May, .	North Adams, .	30	School contact, .	Outbreak started from concealed cases.
February and March,	Winthrop, . .	40	School contact, .	Finally controlled by employing 2 school nurses to follow up absentees and to carry out supervision.
March to May, . .	Sheffield, . .	51	School contact, .	Early cases in private school not recognized.
April, . . .	Georgetown, .	15	School contact, .	Largely among pupils of one school.
April to June, . .	Abington, . .	18	Contact; inefficient quarantine.	- -
April to June, . .	Framingham, .	15	Contact, . .	Initial case, mild, unrecognized.
May, ...	Arlington, . .	5	Milk, . . .	A milk dealer who had 2 cases of scarlet fever in his family supplied 5 cases, and also 12 cases of what was reported as streptococcus sore throat.
May and June, . .	Shelburne, . .	11	School contact, .	Infection introduced by a child returning after indefinite illness in another part of the State. First case, another child in same household, who returned to school as soon as acute symptoms subsided.
September to December.	Pittsfield, . .	56	Contact, . .	- -
September to November.	Northampton, .	40	School contact, .	- -
October, . . .	Barnstable, . .	6	School contact, .	Initial case, mild, found attending school.
October, . . .	West Springfield, .	8	School contact, .	Two mild cases found attending school.
November and December.	Montague, . .	31	Contact; lack of medical care.	Largely in Turners Falls section. Many cases in foreign population without a physician.

Septic Sore Throat.

There were five epidemics of septic sore throat, each due, probably, to milk infected with hemolytic streptococci. No information is available concerning two additional smaller outbreaks, since they were terminated before coming to the attention of the Department.

The records regarding septic sore throat are manifestly incomplete, since but 270 cases were reported, while investigation disclosed at least 594 cases connected with the following outbreaks.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1915,	3,706,931	865	–[1]	23.4	–[1]
1916,	3,779,033	159	67	4.2	1.8
1917,	3,849,006	270	59	7.0	1.5

[1] Not available.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January to March,	Needham and Newton.	50	Milk,	Number of cases estimated; none officially reported. During January physicians noted many children with sore throats. Cases all supplied from a dairy where 2 milk handlers were found whose throat cultures showed the presence of hemolytic streptococci. The same organism was in one of the cows, involving a portion of the udder. Later a second part was found infected.
April,	Somerville and Medford.	150	Milk,	Of the 150 cases estimated as comprising the outbreak, 42 were reported. All had a common milk supply. Investigation showed that the pasteurizer had been out of order. Three employees had worked several days with sore throats. Streptococci were found in the cultures from one of them.
February,	Dedham and Brookline.	125	Milk,	Number of cases estimated; none officially reported. All on same milk route. Inquiry at dairy disclosed 3 employees with sore throats.
April and May,	Gloucester,	150	Milk,	Cases not reported; number estimated. Cases supplied by one dealer who obtained milk from five dairies. At one of them the dairyman and his wife gave cultures showing the presence of hemolytic streptococci.
July and August,	Wellesley, Natick and Dover.	119	Milk,	Forty-two cases reported, others found on investigation. Milk from three sources, supplied by one dealer. At one dairy 2 employees were found with hemolytic streptococci in their throats.

Smallpox.

A total of 65 cases was reported during the year, with 10 fatalities. An account of the Worcester outbreak is given elsewhere. The remaining 17 cases were scattered.

Vaccination History of 1917 Cases.

	Vaccinated within Seven Years.	Vaccinated more than Seven Years Ago.	Not vaccinated.	No History.	Total.
Recovered,	3	27	25	-	55
Died,	-	4	5	1	10
Total,	3	31	30	1	65

It will be observed that with one exception, where the history was unobtainable, all of the fatal cases were vaccinated years ago or not at all.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	157	-	4.4	-
1914,	3,641,553	38	-	1.0	-
1915,	3,706,931	24	9	.6	.24
1916,	3,779,033	32	-	.8	-
1917,	3,849,006	65	10	1.7	.26

Tetanus.

Twenty-eight cases of tetanus were reported, with fifteen deaths, a much smaller number of fatalities than in any one of the past ten years.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	23	33	.6	.9
1914,	3,641,553	31	28	.9	.8
1915,	3,706,931	32	33	.8	.9
1916,	3,779,033	34	31	.9	.8
1917,	3,849,006	28	15	.7	.4

Trachoma.

Eighty-seven cases were brought to the attention of the Department through the local boards of health and the Massachusetts Charitable Eye and Ear Infirmary, nearly 50 per cent. of which were in Boston.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	112	–	3.2	–
1914,	3,641,553	68	–	1.9	–
1915,	3,706,931	50	–	1.4	–
1916,	3,779,033	88	–	2.3	–
1917,	3,849,006	87	–	2.3	–

Trichinosis.

Only 3 cases were reported, 2 in Boston and 1 in North Adams.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	5	4	.14	.11
1914,	3,641,553	5	3	.14	.08
1915,	3,706,931	–	–	–	–
1916,	3,779,033	24	3	.64	.08
1917,	3,849,006	3	2	.08	.05

Tuberculosis, Pulmonary.

Efforts were made to secure more complete reporting of pulmonary tuberculosis by sending circular letters to boards of health in reference to all cases coming unofficially to the knowledge of the Department through laboratory reports, admission and discharge notices from the State sanatoria, death notices from the Secretary of State, and through information received from local exemption boards.

Heretofore, cases have been recorded in a card file by cities and towns. To avoid errors and duplications resulting from misspelled names and double reporting of the same individual from different communities, the filing plan has been changed to an alphabetical system.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913,	3,576,174	7,424	4,180	207.6	116.9
1914,	3,641,553	7,144	4,171	196.2	114.5
1915,	3,706,931	8,046	4,194	217.0	113.1
1916,	3,779,033	7,878	4,466	208.5	118.2
1917,	3,849,006	8,365	4,651	217.3	120.9

Tuberculosis, Non-pulmonary.

More cases of non-pulmonary tuberculosis were reported this year than last, but the deaths were fewer than in any recent year.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	412	869	11.4	24.1
1914, ...	3,641,553	570	890	15.7	24.7
1915, ...	3,706,931	822	853	22.2	23.0
1916, ...	3,779,033	657	955	17.4	25.3
1917, ...	3,849,006	776	758	20.2	19.7

Typhoid Fever.

A total of 1,547 cases were reported. The death rate of 4.6 per 100,000 continues at the gratifyingly low rate of the preceding year. The typhoid situation has been mentioned earlier in this report (see report of Division of Communicable Diseases). A few of the outbreaks or groups of cases investigated are tabulated below.

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	2,398	280	67.0	7.8
1914, ...	3,641,553	2,333	268	64.1	7.4
1915, ...	3,706,931	2,204	247	59.5	6.6
1916, ...	3,779,033	1,515	172	40.1	4.6
1917, ...	3,849,006	1,546	178	40.2	4.6

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January, . . . November and December.	Lawrence, . . Lawrence, . .	11 6	- -	It is noticeable that typhoid fever tends to increase during the colder months of the year, when freezing interferes with the use of the open filters.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January to April,	Amesbury,	5	Contact,	Probably 2 additional cases, all in same household. Early cases diagnosed as "pneumonia," "bronchitis," "endocarditis and septic sore throat," "influenza" and "pneumonia." Widal positive in last 2 cases and pointed to real nature of earlier cases.
April and May, August and September.	Gardner, Gardner,	20 60	Carrier infection through milk.	In June, 1915, the proprietor of the L farm in Gardner started a milk route. By August typhoid fever had occurred in 3 of the 6 families supplied by this farm. During 1916 there were two more cases on this same route. In both years it was suspected that a typhoid carrier was employed on the farm. However Widal tests and examinations of feces and urine from every one on the farm were negative. In April, 1917, there was an explosive outbreak of typhoid fever, numbering 20 cases, all of which were on the route of K, to whom L sold his milk for distribution. A careful investigation by the State Department of Health, together with the local board of health, brought forth the fact that the proprietor of the L farm had typhoid bacilli in his feces although his blood was negative by the Widal test, and he denied ever having had typhoid fever. The sale of milk from this farm was prohibited. On May 6 L was again licensed to sell milk, with the agreement that he personally would have absolutely nothing to do with the handling of the milk or the utensils used. In August, beginning the 16th of the month, 54 cases of typhoid fever were reported, many of which had their onset several days before a physician was called; 6 additional cases were reported in September. All of these cases occurred on the route of the distributor, who obtained milk from 9 dairies, including that of the L farm. The sale of milk from all of the dairies concerned was stopped at once. Subsequently, Widal tests and examinations of the feces and urine of persons at eight of the dairies were negative. The ninth dairy was on the L farm, being the same source of supply which was under suspicion in 1915 and 1916, whose proprietor was found to be a carrier in April of this year. Thus L was proven to be an intermittent carrier with a negative Widal test.

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
June, . . .	Marshfield, . .	5	Carrier infection through milk.	Visitors from Somerville, Dorchester, Quincy, Brookline and New York obtained milk from a dairy where a carrier was found subsequently with typhoid bacilli in the feces.
September and October.	Tewksbury, . .	64	Food handled by an unrecognized case.	An outbreak of explosive character at the State Infirmary in Tewksbury. The cases were practically confined to nurses and attendants, who took their meals in two dining rooms, all of the food coming through the first dining room. Investigation indicated that the infection was introduced by contact either with a chronic carrier or case which was so mild that the nature of it was not recognized. In all probability, the chef, one of the earlier cases if not the earliest, about his work for some time before suspicions were aroused as to the nature of his illness, was an unknown carrier. One of the waitresses, who gave no history of ever having had typhoid fever, showed a strong atypical Widal, characteristic of many carriers. Repeated examinations of stools and urine were negative.

Whooping Cough.

Reported cases were approximately 40 per cent. less than in 1916. That many cases of whooping cough are not reported is evident from the frequent finding of such instances specifically, and also by Worcester's experience in the early part of the year. From January to April 47 cases were reported in Worcester, with 21 deaths, 44 per cent. of the cases being fatal. This gives a death rate of 12.3 per 100,000 population in this outbreak alone, almost double the corresponding rate for the State as a whole in 1917.

Several outbreaks investigated are summarized below: —

Year.	Population.	Cases.	Deaths.	Case Rate per 100,000 Population.	Death Rate per 100,000 Population.
1913, ...	3,576,174	3,325	239	93.0	6.8
1914, ...	3,641,553	3,316	225	91.1	6.2
1915, ...	3,706,931	7,182	283	193.7	7.6
1916, ...	3,779,033	6,447	346	170.6	9.2
1917, ...	3,849,006	3,877	243	100.7	6.3

Date.	Locality.	Cases.	Method of Infection.	Brief History of Outbreak.
January, ...	Clinton, . .	16	Contact, . .	Many cases unreported, no restrictions, no physician.
January, ...	Swampscott, .	58	School contact, .	Cases confined to one school. Nurse engaged to look up absentees and to detect incipient cases of great assistance.
January to April, .	Worcester, . .	47	Contact, . .	During same period 21 deaths from whooping cough reported. Many additional unreported cases without medical attention.

ANTHRAX IN 1917.

The increasing prevalence of human anthrax in Massachusetts, especially since the beginning of the present war, is shown in the following table: —

Year.	Cases.	Deaths.	Year.	Cases.	Deaths.
1907,	1	4	1913,	8	3
1908,	5	2	1914,	8	1
1909,	7	1	1915,	11	3
1910,	7	2	1916,	31	5
1911,	6	2	1917,	54	10
1912,	11	1			

The 1917 cases were reported from 17 cities and towns: —

Locality.	Number of Cases.	Locality.	Number of Cases.
Ayer,	1	North Adams,	1
Berlin,	1	Peabody,	2
Beverly,	1	Salem,	2
Boston,	13	Saugus,	1
Chelsea,	1	Stoneham,	1
Greenfield,	1	Weymouth,	1
Hudson,	1	Winchester,	3
Lynn,	3	Woburn,	1
Malden,	2		

The method of investigation described in the 1916 annual report (page 496) was employed in tracing the source of the infecting materials, which were hides in 48 cases, hair in 3 cases and wool in 1 case. The source of infection was not determined in two instances.

Sun-dried hides, which were responsible for infecting a large majority of the cases, came chiefly from the Hankow district in China and from

the Argentine. Green pickled hides from Buenos Aires were responsible for a few cases.

The hair serving as the vehicle of infection in each instance came from Manchuria and northern China.

A single patient was infected through handling wool from Mexico. Details are summarized below: —

Source of Materials.	Number of Cases.	Totals.
Asia,		35
China,	28	
India,	5	
China and India,	2	
South America,		8
Argentine,	7	
Brazil,	1	
North America,		2
Tennessee,	1	
Mexico,	1	
Mixed sources,		4
China and Argentine,	1	
India and Venezuela,	1	
Tennessee and Argentine,	2	
Undetermined,		5

The diagnosis was confirmed bacteriologically in 37 cases. In 1 instance the diagnosis was confirmed at autopsy. Bacteriological findings were negative in 8 cases, and in 8 further cases no laboratory examination was made. Material was sought in all cases for laboratory examination and animal inoculation in order to confirm the diagnosis. In 7 of the 9 instances where animal inoculation was carried out, the tests were positive. The findings of the inoculation tests agreed with the results of bacteriological examination in the same series of cases.

In 8 instances where the bacteriological findings were negative, or where no such examination was made, the patients were employed at the same time and in handling the same hides which caused other cases of anthrax where the accuracy of the diagnosis was established bacteriologically.

One patient, a hide weigher, had the pulmonary form of anthrax. All other cases were of the external type of the disease.

The 3 cases infected through handling hair occurred in one establishment. Immediately steps were taken to disinfect all hair before its use in manufacturing by subjecting the bundles to live steam under a pressure of 15 pounds for 30 minutes, equivalent to a temperature of 250° F. Afterwards the hair is dried by means of a current of hot air directed through the retort. Since this procedure was established no further cases have been reported in this establishment.

During the year both in industry and in the laboratory, experiments have been continued to determine a satisfactory method of disinfection, one which will destroy the resistant anthrax spores without at the same time injuring the quality of the hides, and consequently the leather made from them.

A slight modification of the Schattenfroh process (mentioned in the preceding annual report, page 502) appears to be satisfactory. The hides are immersed for forty hours in a solution containing 0.75 per cent. of hydrochloric acid gas and 10 per cent. of sodium chloride, at a temperature of 60° to 70° F. Two tanneries where cases of anthrax occurred have had no cases among their employees since using this process, though continuing to obtain hides from the same sources as before. Thus far the method has been used only for upper leathers.

Laboratory experiments, conducted for the Department by Dr. Francis H. Slack of the Sias Laboratories, showed that solutions containing from 0.75 to 2 per cent. of hydrochloric acid gas and 5 to 10 per cent. of sodium chloride sufficed to kill anthrax spores after forty hours of exposure. The same was true of a 2 per cent. solution of hydrochloric acid gas. Solutions containing less than 0.75 per cent. of the gas were ineffective.

Further discussion of preventive measures may be found in the 1916 annual report.

SMALLPOX IN WORCESTER.

During the early part of the year a smallpox outbreak of unusual virulence occurred in Worcester and vicinity; 38 of the 48 cases were in Worcester, 4 were reported from Fitchburg and 3 each from Shrewsbury and Webster.

The first case was reported from Worcester on January 24, the onset dating back to January 16. The patient was an inmate of a Finnish boarding house. Investigation at this time disclosed that a Finnish immigrant, recently landed in New York, had arrived at the same boarding house in Worcester on January 4. He had a fresh vaccination mark on his arm. He shortly departed, and information as to the ship upon which he arrived was not available.

When the March and April cases appeared further inquiry was made concerning the immigrant in question. Information was secured showing that he must have arrived in New York on Dec. 24, 1916, on the steamer "Kristianfjord," which had on board a fatal case of smallpox.

Apparently infection was brought to Worcester by this immigrant, who had possibly a very mild attack of the disease, owing to his recent vaccination, for the first case was a fellow inmate of the Finnish boarding house; the succeeding 4 cases were Finns in the immediate vicinity of the boarding house. Further confirmation of this conclusion is found in the experience of Eveleth, Minn., where a severe type of smallpox appeared in February. It was found that previous to its appearance three passengers from the "Kristianfjord" had arrived in Eveleth, though they themselves were not ill so far as known.

Information from the health officer of the port of New York gave the following details in regard to smallpox on the "Kristianfjord": —

Number of cases of smallpox removed,	1
Number of direct contacts removed,	24
Number of indirect contacts removed,	422

The indirect contacts in this case were discharged only after successful vaccination on the morning of Jan. 4, 1917, and were sent to Ellis Island, where they were doubtless discharged the same day and from which point doubtless an immigrant could have reached Worcester, Mass.

The case on the steamer had been isolated for five days prior to her arrival, so that the connection of the bulk of indirect contacts was relatively slight, and the treatment of bathing bodies, fumigation of effects and vaccination at the

Quarantine Station were elaborate under the circumstances, and it was thought efficient, but the possibility that the case in Worcester is connected with the infection on the "Kristianfjord" is unquestionably present.

Treatment: usual quarantine detention, vaccination (percentage of takes 96 per cent.) and fumigation of effects. Some of the direct contacts were discharged on Jan. 9 and others were held until Jan. 15, 1917. The case of smallpox died, but there were no further cases up to the time the quarantine incident closed.

The spread of the disease and details of cases are shown in a chart and table at the conclusion of this summary.

The relation of Case 12 to the spread of infection is interesting in that in the eruptive stage of the disease he attended a meeting of the local molders' union and was responsible for the infection of 15 cases with 22 secondary cases, including those in New York, mentioned below. A molder from Watervliet, N. Y., also attended this meeting and returned home the following day. Later he developed smallpox and was responsible for the infection of 7 additional cases.

The fatality rate, which was unusually high for New England, and the vaccination history of the Massachusetts cases are shown in the following tables: —

Fatality Rate.

Community.	Cases.	Deaths.	Fatality Rate (Per Cent.).
Worcester,	38	9	23.7
Fitchburg,	4	1	25.0
Shrewsbury,	3	–	–
Webster,	3	–	–
Totals,	48	10	20.8

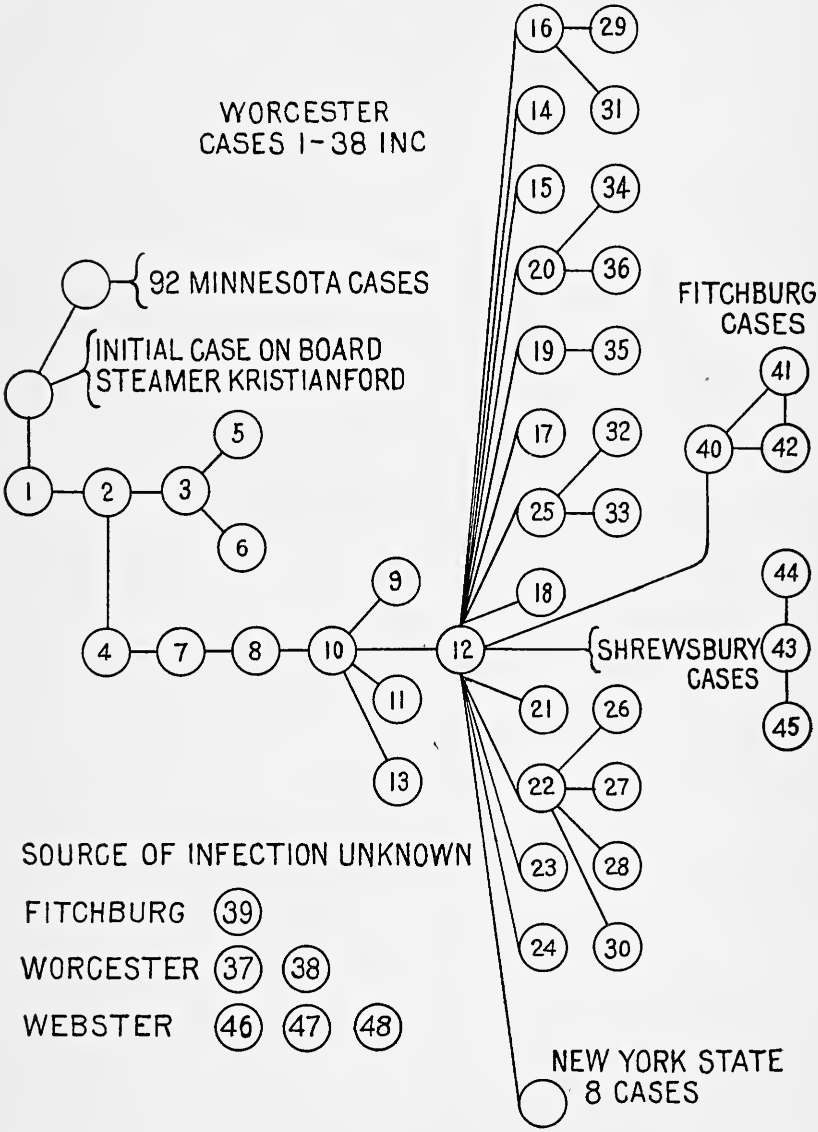
Vaccination History.

	Number.	Vaccinated since 1910.	Vaccinated before 1910.	Never successfully vaccinated.	Vaccination History uncertain.
Fatal Cases.					
Hemorrhagic,	6	–	3	2	1
Confluent,	3	–	–	3	–
Discrete,	1	–	–	1	–
Recovered Cases.					
Hemorrhagic,	–	–	–	–	–
Confluent,	10	2	7	2	–
Discrete,	14	–	4	9	–
Very mild,	14	2	6	6	–
Totals,	48	4	20	23	1

Notwithstanding the virulent type of the disease indicated by a fatality rate of 20.8 per cent., but 3 deaths occurred among the 24 vaccinated individuals, — and these were among individuals who had been vaccinated previous to 1910, — while 6 deaths occurred among the unvaccinated individuals.

In Worcester, Shrewsbury and Webster all cases were immediately removed to isolation hospitals. Fitchburg cases were cared for in their own homes. In all the communities active measures were taken to trace all contacts and to secure their vaccination. General vaccination was encouraged, especially in Worcester, where 12,776 persons were vaccinated.

SMALLPOX EPIDEMIC IN MASSACHUSETTS
1917



Tuberculosis Subsidy Survey Report.

In May, 1917, the Legislature passed the following act: —

Chapter 290, General Acts of 1917.

An Act relative to Subsidies to Cities and Towns on Account of Consumptive Patients as determined by the Bed Capacity of Certain Hospitals.

Be it enacted, etc., as follows:

Section 1. Chapter five hundred and ninety-seven of the acts of the year nineteen hundred and eleven, as amended in section one by section one of chapter six hundred and thirty-seven of the acts of the year nineteen hundred and twelve, and by chapter fifty-seven of the General Acts of the year nineteen hundred and sixteen, is hereby further amended by striking out the said section and inserting in place thereof the following: — *Section 1.* Every city or town which places its patients suffering from tuberculosis in a municipal or incorporated tuberculosis hospital in this commonwealth, or in a building or ward set apart for patients suffering from tuberculosis by a municipal or incorporated hospital in this commonwealth, shall be entitled to receive from the commonwealth a subsidy of five dollars a week for each patient who is unable to pay for his support, or whose kindred bound by law to maintain him are unable to pay for the same; but a city or town shall not become entitled to this subsidy unless, upon examination authorized by the trustees of hospitals for consumptives, the sputum of such patient be found to contain bacilli of tuberculosis, nor unless the hospital building or ward be approved by said trustees, who shall not give such approval unless they have by authority of law, or by permission of the hospital, full authority to inspect the same at all times. Said trustees may at any time withdraw their approval: *provided, however,* that in the case of those hospitals having a bed capacity which is in excess of the number of beds needed for the localities which these institutions serve for patients exhibiting tubercle bacilli in their sputum, the subsidy above provided shall be allowed for such patients not exhibiting tubercle bacilli in their sputum as in the joint opinion of the superintendent of the institution and of the state district health officer of the district in which the hospital is situated are bona fide cases of consumption and have been in the institution more than thirty days. The determination of the question of the number of beds in excess of the number of beds needed for patients exhibiting tubercle bacilli in their sputum shall be made as follows: — the city board of health shall first file an application for a tuberculosis survey of the localities served by such tuberculosis hospital, stating in the appli-

cation the reasons for the belief that the hospital is already providing proper care for all cases showing tubercle bacilli and subject to hospital treatment. On receipt of such an application the state department of health and the state trustees of hospitals for consumptives shall cause a careful survey to be made by representatives of both departments.

Following the filing of the report of such survey the public health council of the state department of health and the trustees of hospitals for consumptives, sitting jointly, shall determine and decree the average number of beds needed in such institutions for patients exhibiting tubercle bacilli in their sputum. This number shall be subject to redetermination by a new survey made in a similar manner from time to time thereafter upon application by the city board of health, but such application shall not be made more often than once in three years.

SECTION 2. This act shall take effect upon its passage. [*Approved May 24, 1917.*

In accordance with the provisions of this act, and shortly after its passage, the board of health of New Bedford made a written request to the Trustees of Hospitals for Consumptives and to the State Department of Health jointly for a tuberculosis survey in the following letter: —

JUNE 20, 1917.

To the State Department of Health and the Trustees of Hospitals for Consumptives.

In accordance with chapter 290 of the General Acts of 1917, the Board of Health of New Bedford hereby makes application for a tuberculosis survey of New Bedford as provided in said act.

The board believes that the work done in New Bedford for the control of tuberculosis justifies it in asking that the subsidy heretofore available for bacillary cases alone be now granted for the nonbacillary cases that are being cared for at the New Bedford Sanatorium.

As required by law the board submits the following reasons for its "belief that said hospital is already providing proper care for all cases showing tubercle bacilli and subject to hospital treatment": —

The number of cases in the sanatorium May 28 was 105, about evenly divided between positive sputum and negative sputum cases. Of the 105, 10 were State cases, 84 city cases and 11 out-of-town or private cases, the latter being self-supporting. A classification as of March 5 showed out of 102 cases 52 positive and 50 negative, which indicates the adequacy of the accommodations for the positive cases. In fact the number of beds at the hospital is now far in excess of the number required to take care of the positive sputum cases.

The policy of New Bedford has always been to give preference in hospital treatment to the advanced cases, in order to remove from the community those who were especially a menace to the public health. The extent to which this policy has been pursued is partially shown by the number of deaths, which were 23 in 1910, 26 in 1911, 16 in 1912, 40 in 1913, 44 in 1914, 44 in 1915, and 46 in

1916. These figures show that an effort has constantly been made to give the worst cases hospital treatment.

The limitation of the subsidy to the bacillary cases was justified when the anti-tuberculosis work was in its early stages, as it created an incentive to communities to direct their efforts toward the cleaning up of the advanced cases. So far as New Bedford is concerned this consideration no longer governs. There has been and will be no relaxation of these efforts, but the city has so well accomplished the cleaning up of the advanced cases that the pressing problem now to be attacked is the moderately advanced cases, in the hope that they may be so benefited by hospital treatment as to be able to return to their homes and their usual vocations.

It is extremely desirable that these cases be treated in a sanatorium near their homes. Patients frequently object to going to State sanatoria because of the distance which prevents their relatives visiting them, and there is no way in which they can be compelled to go to a hospital against their wishes.

The board believes that the best results can be secured by sending these cases to the local sanatorium, and that as most of them are of the nonbacillary type the subsidy should be allowed for them as well as for the bacillary cases, particularly as the hospital facilities are more than sufficient for the latter.

We therefore make application for the survey provided by law as a preliminary to the granting of the subsidy in nonbacillary cases.

In response to this request, as required under the act, representatives of the State Department of Health and the Trustees of Hospitals for Consumptives conducted a tuberculosis survey in New Bedford.

For the purpose of the investigation a card catalogue was prepared of all known cases of tuberculosis in New Bedford during the period of three years and four months, from July, 1914, to November, 1917. This was based upon (1) records of the New Bedford board of health; (2) records of deaths from the city clerk's office; (3) records of the New Bedford Tuberculosis Dispensary; (4) records from the New Bedford Tuberculosis Sanatorium; (5) records from the State sanatoria and other State institutions; and (6) records from the State Department of Health.

These records were studied and verified so far as possible by a house-to-house canvass of all listed cases. The canvass was rendered much more difficult because of the large foreign-born population, mostly Portuguese, which frequently changes its place of abode.

The results of this canvass in New Bedford, a city of 109,568 population, are shown in the following tabulation: —

Total number of patients discovered,	1,543
Total number of patients living,	694
Total number of patients dead,	581
Total number of patients who left city,	187

Total number of patients not located,	81
Number of patients who have been in sanatoria or hospitals,	667
Number of patients in New Bedford Sanatorium,	555
Number of patients in State or other institutions,	112
Number of patients who were treated in New Bedford Sanatorium —	
With New Bedford settlements,	406
With State settlements,	74
With settlements elsewhere,	18
With unknown settlements,	57
Of the 555 patients treated in the New Bedford Sanatorium there are —	
In the sanatorium at present,	109
In State and other institutions,	21
Total number of patients living in their homes,	564
Of 564 patients living at home —	
With positive sputa,	45
With negative sputa,	59
With no sputum,	378
With unknown,	82

Two of these groups, those which have been and are now at the New Bedford Tuberculosis Sanatorium and those who are now in their homes, are particularly important.

The present bed capacity of the New Bedford Tuberculosis Sanatorium is 103, and plans are under way for 10 additional beds. During the summer of 1917, by the use of tents, from 112 to 114 patients were accommodated. On Oct. 31, 1917, there were 105 patients at the institution, grouped as follows: —

Number of adults with positive sputum,	63
Number of children with positive sputum,	2
Number of adults with negative sputum,	16
Number of children with negative sputum,	24

Of the 555 patients who are in or have been in the New Bedford Sanatorium, 321, or 58 per cent., were in the advanced stages when admitted; 122, or 22 per cent., were moderately advanced; 60, or 11 per cent., were incipient; and 52, or 9 per cent., were unclassified. The waiting periods before admission to the sanatorium were as follows: no wait, 282; two weeks to one month, 114; over one month, 55; unknown, 104.

In regard to the 581 patients who died, it was found that 303 had been in tuberculosis institutions; 242 of this number were in the New Bedford Sanatorium.

Of the 278 patients who had never been in tuberculosis institutions

112 were advised to enter; 94 were under care of private physicians and were not advised; 7 had no physician until death; 12 were children and too young to be admitted; and 53 no information was obtainable.

Of the 112 who were advised to go to the hospital 70 refused to go; 37 waited admission and when vacancy came were so near death they refused to leave home; and 5 desired to enter, but no arrangements were made for their admission to an institution.

Of the 564 patients living at home, 234 had been in tuberculosis institutions. Of these, 204 had been in the New Bedford Sanatorium. Of these 564 patients, 214 were under medical supervision, though but 57 were under the regular supervision of the board of health nurse. The board of health employs three nurses, who divide their time between infant welfare and tuberculosis work. Many patients who are under the care of private physicians and the dispensary are not visited by these nurses, it being assumed that the patient is under constant supervision.

That there is a distinct group which escapes supervision, between those cared for by private physician and nurse and those under the care of the dispensary and nurse, is shown by facts obtained during the canvass. For example, 11 patients supposed to be under the care of a private physician had positive sputum but had not seen their physicians for months, and were not being visited by any one. Likewise the physical examination of the members of a family exposed to tuberculosis, particularly the children, was found to be the exception and not the rule.

Of the 564 patients who were seen in their homes, 45 had positive sputum. Of these patients, 27 were never in tuberculosis institutions; 18 had been advised to seek institutional treatment, but refused to go. It is doubtful if the remainder of this group (those not advised to enter an institution) would have been willing to go unless frequently visited and educated up to the necessity of taking treatment.

Although the visiting in the poorer sections of the city became practically a house-to-house canvass in searching for patients who had changed addresses, no patients in the advanced stages of the disease were found, except those already known to the board of health. Several times an interested neighbor would speak of a consumptive who lived on a near-by street, but in each instance it was a patient whose name was already on the board of health list as a reported case. Nevertheless, although we have not been able to demonstrate this fact we firmly believe that there is a small but definite per cent. of patients in the advanced stages of the disease who have had no medical super-

vision and have worked up to the time of death. We believe the only way in which these patients can be reached is by medical inspection in the mills and factories, by a more intensive educational campaign, and by home visiting.

A brief summary of this survey shows the following facts: during the past three years and four months in the city of New Bedford there have been 1,543 patients with pulmonary tuberculosis, an average of 463 per year; of these 694 are now alive, 581 are dead; 667 received adequate treatment in the New Bedford Tuberculosis Sanatorium or in State or other institutions; 608 did not receive institutional treatment of any kind for the following reasons: (1) refused to go; (2) no arrangements made; (3) application made when patient was too near death; (4) not advised; (5) disagreement in diagnoses; not discovered; worked up to time of death. Of the 564 patients living at home, 45 had positive sputum, 59 had negative sputum, 378 were unexamined because they said they had no sputum, and 82 were unknown.

It would seem to us as a result of the information which we have obtained and which we give in this report that New Bedford has cared for its tuberculous patients, with the exceptions noted above, in a fairly adequate manner.

The Trustees of Hospitals for Consumptives and the State Department of Health subsequently granted the request for a subsidy in non-bacillary cases in excess of 75 beds, this number being reserved for acute cases.

Table giving the Death Rate per 1,000 Population from All Causes in Massachusetts, 1913–17.

Year.	Population.	Deaths.	Death Rate per 1,000 Population.
1913,	3,576,174	53,402	14.9
1914,	3,641,553	52,978	14.5
1915,	3,706,931	53,131	14.3
1916,	3,779,033	56,366	14.9
1917,	3,849,006	56,635	14.7

INCIDENCE OF COMMUNICABLE DISEASES BY MONTHS, 1917.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
Actinomycosis,	–	–	–	–	–	1	–	–	1	–	2	–	4
Anterior poliomyelitis,	14	2	8	9	9	15	38	38	16	11	10	4	174
Anthrax,	1	–	3	5	12	9	–	2	6	8	4	4	54
Chicken pox,	852	791	885	660	913	799	203	74	73	263	669	1,028	7,210
Diphtheria,	869	783	858	738	876	793	597	590	729	1,152	1,181	1,156	10,322
Dog bite (requiring antirabic treatment),	4	3	4	3	7	9	9	3	2	9	4	3	60
Dysentery,	1	1	2	2	2	7	8	48	73	12	3	1	160
Cerebrospinal meningitis,	11	9	16	17	23	36	15	19	8	11	16	15	196
German measles,	41	173	541	905	1,767	1,761	215	54	19	19	144	251	5,890
Glanders,	1	–	–	–	–	–	–	1	–	–	–	–	2
Hookworm disease,	–	–	–	–	–	–	–	–	1	–	–	–	1
Leprosy,	–	–	–	–	2	–	1	–	–	–	–	–	3
Malaria,	1	2	5	2	5	16	11	13	12	7	2	2	78
Measles,	1,886	2,197	2,852	3,170	4,234	3,832	1,347	380	241	589	1,232	1,920	23,880
Mumps,	745	689	1,181	1,039	1,158	828	287	123	87	160	363	465	7,125
Ophthalmia neonatorum,	202	191	199	197	225	184	152	209	170	210	191	195	2,325[1]
Pellagra,	–	–	1	3	1	7	2	3	3	4	1	3	28
Pneumonia, lobar,[2]	–	–	–	–	360	277	80	57	80	152	290	460	1,756
Scarlet fever,	672	597	721	652	567	412	241	145	248	440	587	671	5,953
Septic sore throat,	20	16	30	62	21	13	27	36	10	8	10	17	270
Smallpox,	2	2	5	5	27	10	1	1	1	–	1	10	65
Tetanus,	2	2	–	1	1	4	2	8	–	1	5	2	28
Trachoma,	6	3	6	7	13	7	5	10	5	8	9	8	87
Trichinosis,	–	1	1	–	–	–	–	1	–	–	–	–	3
Tuberculosis, pulmonary,	711	652	698	725	699	736	821	693	634	687	702	607	8,365
Tuberculosis, other forms,	62	72	67	55	68	65	65	67	57	53	85	60	776
Typhoid fever,	68	45	69	111	66	104	109	246	264	246	120	98	1,546
Whooping cough,	277	181	279	263	355	328	344	338	261	236	421	594	3,877
Totals,	6,448	6,412	8,431	8,631	11,411	10,253	4,580	3,159	3,001	4,286	6,052	7,574	80,238

[1] Including 307 cases of suppurative conjunctivitis.

[2] Made reportable May 1, 1917.

Cases and Deaths from Diseases Dangerous to the Public Health, 1917.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1917.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1917 — Continued.

Index to Line Numbers in the Table of Cases and Deaths from Diseases Dangerous to the Public Health, 1917 — Concluded.

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis.		19A Chicken Pox.		9 Diphtheria.		14 Dysentery.		61A Epi. Cerebrospinal Meningitis.		19B German Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
1	Massachusetts,	3,849,006	174	**51**	7,210	**20**	10,322	**838**	160	**64**	196	**158**	5,890	**5**
2	Cities over 200,000.													
3	Boston,	778,500	13	**5**	1,815	**9**	3,473	**282**	56	**5**	51	**44**	1,061	–
4	Cities, 150,000-200,000.													
5	Worcester,	170,077	6	**3**	166	**1**	388	**40**	1	**4**	6	**10**	104	–
6	Cities, 100,000-150,000.	*570,968*	*27*	*12*	*863*	*3*	*1,738*	*160*	*4*	*9*	*45*	*33*	*1,607*	*2*
7	Fall River,	127,218	5	**1**	121	–	219	**38**	3	**3**	8	**5**	124	**1**
8	New Bedford,	115,272	–	–	164	–	122	**16**	1	**1**	5	**9**	277	–
9	Cambridge,	110,582	3	**1**	276	**2**	493	**16**	–	–	5	**1**	494	–
10	Springfield,	109,174	10	**8**	254	–	449	**63**	–	**4**	10	**7**	696	**1**
11	Lowell,	108,722	9	**2**	48	**1**	455	**27**	–	**1**	17	**11**	16	–
12	Cities, 50,000-100,000.	*511,498*	*65*	*7*	*842*	*2*	*1,157*	*114*	*11*	*5*	*18*	*18*	*338*	–
13	Lynn,	98,659	11	**2**	87	–	157	**16**	–	**1**	5	**5**	100	–
14	Lawrence,	92,187	3	**1**	101	**1**	148	**13**	9	**3**	3	**6**	2	–
15	Somerville,	91,102	3	–	99	–	257	**27**	1	–	2	**2**	45	–
16	Brockton,	64,668	5	–	233	–	95	**3**	–	–	2	**2**	30	–
17	Holyoke,	62,179	–	–	58	–	98	**20**	1	**1**	1	–	67	–
18	Haverhill,	51,806	40	**2**	121	–	186	**13**	–	–	2	**2**	16	–
19	Malden,	50,897	3	**2**	143	**1**	216	**22**	–	–	3	**1**	78	–
20	Cities and Towns, 25,000-50,000.	*498,330*	*10*	*8*	*1,052*	–	*1,078*	*80*	*3*	*5*	*30*	*20*	*539*	*1*
21	Chelsea,	48,273	1	**1**	118	–	157	**12**	–	–	5	**2**	16	–
22	Newton,	44,573	1	**1**	85	–	73	**9**	2	–	–	–	109	–
23	Quincy,	44,221	3	**2**	68	–	88	**1**	–	–	1	–	19	–
24	Pittsfield,	42,913	–	–	46	–	42	**7**	–	–	16	**7**	94	**1**
25	Fitchburg,	40,464	–	–	79	–	146	**14**	–	**1**	–	–	3	–
26	Salem,	39,872	1	**2**	133	–	38	**2**	1	**1**	1	**1**	26	–
27	Everett,	39,588	1	**1**	84	–	173	**12**	–	–	1	**1**	34	–
28	Taunton,	37,001	–	–	29	–	28	**3**	–	**1**	–	–	5	–
29	Brookline,	36,007	–	–	180	–	39	–	–	–	1	**1**	81	–
30	Medford,	33,758	1	**1**	80	–	63	**4**	–	**1**	1	**1**	56	–
31	Chicopee,	32,230	1	–	27	–	70	**8**	–	**1**	1	**3**	64	–
32	Waltham,	31,179	–	–	123	–	68	**5**	–	–	2	**3**	32	–
33	Revere,	28,251	1	–	–	–	93	**3**	–	–	1	**1**	–	–
34	Cities and Towns, 10,000-25,000.	*569,407*	*18*	*7*	*1,162*	*1*	*1,287*	*80*	*10*	*16*	*31*	*23*	*765*	*2*
35	Beverly,	24,863	4	**2**	57	–	12	–	–	–	7	**3**	20	–
36	Gloucester,	24,513	–	–	13	–	12	**5**	–	–	3	**2**	13	–
37	Northampton,	22,636	1	–	57	–	23	**4**	1	**1**	4	**3**	34	–
38	North Adams,	22,042	–	–	39	–	14	**4**	–	**2**	1	**1**	2	–
39	Peabody,	19,908	1	–	21	–	11	–	1	**2**	3	**2**	3	–
40	Attleboro,	19,480	–	–	117	–	48	**3**	–	**2**	2	–	40	–
41	Westfield,	19,456	–	–	13	–	44	**4**	–	–	–	–	64	–
42	Watertown,	18,123	–	–	30	–	91	–	–	–	1	–	19	–
43	Leominster,	17,675	–	–	34	–	44	**6**	–	**2**	–	–	8	–

[1] Including 307 cases of suppurative conjunctivitis.

to the Public Health, 1917.

92 Lobar Pneumonia.		6 Measles.		19C Mumps.		38A[1] Ophthalmia Neonatorum.		7 Scarlet Fever.		100 Septic Sore Throat.		75A Trachoma.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		
Cases.[2]	Deaths.[3]	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
1756	4028	23880	371	7,125	5	2,325	3	5953	120	270	59	87	–	8365	4651	776	758	1,546	178	3,877	243	1
																						2
423	1085	5,652	104	1,693	1	963	2	1193	48	61	13	42	–	2770	1138	204	174	181	23	936	42	3
																						4
136	216	234	13	91	–	157	–	397	7	3	–	10	–	368	218	25	58	60	10	91	32	5
321	598	4,635	124	641	–	429	1	810	16	23	16	4	–	1594	793	152	152	451	50	571	57	6
72	127	1,631	69	89	–	123	1	84	3	3	–	–	–	479	188	34	30	264	22	277	24	7
64	118	782	26	72	–	118	–	120	–	4	1	1	–	424	148	42	41	63	9	68	16	8
67	111	1,297	15	260	–	86	–	165	3	11	3	1	–	269	208	30	18	33	5	102	4	9
88	129	560	5	193	–	59	–	364	7	3	6	–	–	205	102	35	25	54	7	105	5	10
30	113	365	9	27	–	43	–	77	3	2	6	2	–	217	147	11	38	37	7	19	8	11
228	485	1,719	12	965	1	312	–	779	14	42	5	14	–	916	517	105	92	162	27	563	25	12
43	101	145	1	47	–	83	–	188	4	1	1	3	–	168	111	24	21	50	7	148	3	13
23	77	30	–	23	–	14	–	41	1	–	–	7	–	176	131	26	27	37	6	88	5	14
28	74	380	2	28	–	41	–	204	3	35	2	–	–	154	77	12	8	25	6	25	1	15
27	54	46	–	698	–	81	–	62	–	1	–	1	–	111	37	18	9	12	–	206	4	16
18	71	522	7	5	–	19	–	119	–	1	–	1	–	97	65	–	15	9	4	13	6	17
69	62	170	1	46	–	3	–	81	3	4	1	1	–	125	60	18	3	18	4	59	4	18
20	46	426	1	118	1	31	–	84	3	–	1	1	–	85	36	7	9	11	–	24	2	19
252	450	3,026	31	981	–	201	–	665	5	42	5	10	–	917	492	113	85	151	13	699	25	20
60	56	217	2	34	–	67	–	42	–	5	–	6	–	129	53	13	6	31	3	56	1	21
26	38	563	2	381	–	12	–	40	–	13	1	–	–	3	17	5	6	23	–	57	1	22
12	30	104	–	122	–	19	–	47	–	–	–	–	–	96	48	14	6	12	2	48	3	23
25	44	510	10	21	–	16	–	102	3	–	–	–	–	82	52	11	8	5	1	78	5	24
32	24	197	2	78	–	11	–	58	1	–	–	2	–	100	41	13	7	5	–	41	4	25
18	43	218	2	43	–	11	–	25	–	–	–	1	–	84	51	22	12	3	–	244	8	26
24	35	317	4	45	–	24	–	72	–	–	–	–	–	61	22	13	3	23	–	24	1	27
3	57	17	4	8	–	7	–	56	–	1	–	1	–	81	70	4	11	9	1	3	–	28
11	25	198	–	110	–	3	–	58	1	7	2	–	–	39	16	7	5	6	–	63	–	29
13	30	381	1	29	–	8	–	45	–	14	–	–	–	31	22	3	2	13	1	13	–	30
13	21	65	1	–	–	13	–	31	–	2	1	–	–	100	59	4	5	4	1	23	2	31
9	27	237	2	110	–	6	–	34	–	–	1	–	–	37	30	4	10	8	1	49	–	32
6	20	2	1	–	–	4	–	55	–	–	–	–	–	43	11	–	4	9	3	–	–	33
230	519	4,303	46	1,469	3	146	–	1084	12	71	11	4	–	847	495	89	79	284	27	502	27	34
9	21	31	–	6	–	12	–	28	–	2	–	–	–	35	17	3	1	8	–	26	2	35
6	32	14	1	3	–	5	–	10	–	1	1	–	–	36	27	13	4	22	2	–	–	36
4	15	281	2	97	1	1	–	91	–	1	–	–	–	70	59	2	3	2	–	5	–	37
7	27	422	4	14	–	4	–	32	–	–	1	–	–	45	15	4	3	18	2	41	–	38
9	23	17	–	4	–	9	–	11	–	–	–	1	–	50	12	5	2	7	1	30	1	39
6	9	35	–	27	–	5	–	40	–	1	–	–	–	25	17	1	4	4	–	23	1	40
22	22	641	14	10	–	5	–	123	4	–	–	–	–	51	38	1	2	4	–	–	–	41
3	11	152	1	33	–	4	–	23	1	–	–	–	–	31	16	3	1	8	1	8	–	42
18	19	31	–	11	–	6	–	19	–	2	–	–	–	42	11	9	2	3	1	14	–	43

[2] Made reportable May 1, 1918.

[3] Deaths for the entire year.

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis.		19A Chicken Pox.		9 Diphtheria.		14 Dysentery.		61A Epi. Cerebrospinal Meningitis.		19B German Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
44	Melrose,	17,394	–	–	119	–	86	1	–	–	–	–	48	–
45	Framingham,	17,146	–	–	105	–	12	3	–	–	–	–	149	–
46	Gardner,	17,116	1	–	62	–	281	13	–	2	4	4	5	–
47	Woburn,	16,896	1	1	16	–	21	2	–	–	–	–	10	–
48	Arlington,	16,524	–	–	8	–	27	1	–	–	1	2	23	–
49	Marlborough,	15,546	1	–	28	–	22	–	–	–	–	–	21	–
50	Newburyport,	15,470	–	–	57	–	19	2	–	1	1	1	19	2
51	Methuen,	15,137	–	–	6	–	18	1	–	–	–	2	–	–
52	Southbridge,	14,930	–	–	4	–	15	3	–	–	–	2	–	–
53	Weymouth,	14,444	1	1	–	–	12	1	–	–	–	–	–	–
54	Milford,	13,962	–	–	19	–	26	–	–	1	2	–	1	–
55	Winthrop,	13,918	–	–	34	–	7	–	–	–	1	1	47	–
56	Greenfield,	13,590	1	1	129	–	19	–	8	–	1	–	55	–
57	Wakefield,	13,389	–	1	7	–	21	2	–	–	–	–	2	–
58	Adams,	13,302	–	–	2	–	22	3	–	–	–	–	3	–
59	Plymouth,	13,273	–	–	8	–	29	4	–	–	–	–	15	–
60	Clinton,	13,243	–	–	17	–	5	–	–	1	–	–	2	–
61	Webster,	13,031	–	–	32	–	71	5	–	–	–	–	–	–
62	Norwood,	12,286	–	–	24	–	24	–	–	–	–	–	45	–
63	West Springfield,	12,273	1	1	–	–	56	3	–	–	–	–	2	–
64	Danvers,	11,955	1	–	30	1	30	–	–	–	–	–	20	–
65	Dedham,	11,820	–	–	21	–	39	3	–	–	–	–	9	–
66	Natick,	11,673	1	–	17	–	19	–	–	–	–	–	–	–
67	Saugus,	11,189	3	–	–	–	26	1	–	–	–	–	–	–
68	Easthampton,	10,430	–	–	3	–	38	3	–	1	–	–	–	–
69	Athol,	10,333	–	–	7	–	20	3	–	1	–	–	–	–
70	Winchester,	10,312	–	–	17	–	8	–	–	–	–	–	63	–
71	Bridgewater,	10,129	1	–	9	–	15	–	–	–	–	–	23	–
72	Towns, 5,000–10,000.	*355,823*	*19*	*5*	*801*	*2*	*676*	*36*	*12*	*12*	*6*	*3*	*653*	–
73	Braintree,	9,907	–	–	50	–	20	1	1	1	–	–	8	–
74	Palmer,	9,847	1	1	1	–	7	–	–	3	1	–	3	–
75	Ware,	9,580	–	–	20	–	2	–	–	1	1	1	–	–
76	North Attleborough,	9,470	–	–	11	–	67	–	–	–	–	–	1	–
77	Northbridge,	9,451	–	–	2	–	18	–	–	–	–	–	–	–
78	Belmont,	9,203	–	–	6	–	32	–	–	–	1	–	19	–
79	Milton,	8,898	–	–	21	–	26	1	–	–	–	–	61	–
80	Middleborough,	8,815	–	–	13	–	4	–	–	–	–	–	13	–
81	Montague,	8,393	–	–	3	–	6	1	–	–	–	–	1	–
82	Andover,	8,277	–	–	61	–	11	1	–	–	–	–	81	–
83	Amesbury,	7,947	1	–	7	–	98	4	–	–	–	–	4	–
84	Swampscott,	7,849	–	–	20	–	2	–	–	–	–	–	15	–
85	Marblehead,	7,725	–	–	–	–	3	–	–	–	–	–	6	–
86	Stoneham,	7,665	3	1	21	–	8	–	–	–	–	1	22	–
87	Whitman,	7,621	2	–	26	–	34	–	–	–	–	–	12	–
88	Stoughton,	7,276	–	–	8	–	8	1	–	–	–	–	–	–
89	Reading,	7,241	1	–	8	–	9	–	–	–	–	–	3	–
90	Needham,	7,211	1	1	2	–	6	–	–	–	–	–	45	–
91	Rockland,	7,138	–	–	11	–	30	5	–	–	–	–	–	–
92	Maynard,	6,938	1	1	3	–	6	–	–	–	1	–	1	–
93	Great Barrington,	6,936	–	–	2	–	21	–	–	–	–	–	16	–
94	Wellesley,	6,892	1	–	148	–	14	1	–	–	–	–	76	–
95	Ludlow,	6,827	1	–	5	–	17	3	–	–	–	–	3	–
96	Concord,	6,796	–	–	41	–	9	1	–	–	–	–	72	–
97	Franklin,	6,793	–	–	8	–	12	1	–	–	–	–	5	–
98	Fairhaven,	6,787	–	–	2	–	4	1	–	–	–	–	4	–
99	Hudson,	6,765	–	–	–	–	6	–	–	–	–	–	–	–
100	Ipswich,	6,491	–	–	64	–	12	–	–	1	–	–	3	–
101	Grafton,	6,470	–	–	2	–	5	–	–	–	–	1	–	–
102	North Andover,	6,144	1	–	–	–	5	2	–	–	–	–	4	–
103	Westborough,	6,137	–	–	3	1	5	–	5	3	–	–	1	–

to the Public Health, 1917 — Continued.

92 Lobar Pneumonia.		6 Measles.		19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		100 Septic Sore Throat.		75A Trachoma.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
12	**13**	290	**2**	3	-	24	-	40	-	4	-	-	-	16	**10**	1	**1**	3	-	6	-	44
8	**15**	182	**2**	485	-	2	-	36	-	3	-	-	-	56	**9**	3	**2**	1	-	2	-	45
3	**15**	42	-	25	-	3	-	45	-	1	-	-	-	31	**20**	3	**1**	95	**9**	11	-	46
1	**14**	79	-	5	-	2	-	44	-	-	-	-	-	22	**16**	3	**5**	5	-	2	**1**	47
-	**9**	281	**1**	3	-	2	-	41	**1**	4	**1**	1	-	20	**13**	3	**1**	8	**1**	5	-	48
5	**14**	11	-	7	-	3	-	14	-	-	-	-	-	38	**8**	7	**5**	2	-	26	**2**	49
6	**23**	355	**3**	11	-	7	-	19	-	8	**1**	-	-	16	**5**	2	**1**	11	**1**	3	-	50
3	**10**	7	-	1	-	-	-	16	-	-	**1**	-	-	16	**13**	1	**5**	7	-	3	**4**	51
2	**14**	1	-	-	-	1	-	1	-	-	**2**	-	-	21	**9**	3	**4**	7	**1**	-	**1**	52
1	**10**	10	-	-	-	2	-	5	-	-	-	1	-	11	**11**	-	**2**	2	-	-	-	53
6	**17**	17	-	11	-	2	-	38	-	-	-	-	-	12	**10**	3	**3**	3	-	18	**1**	54
16	**11**	118	**1**	62	-	4	-	75	-	-	-	-	-	16	**5**	3	-	3	-	43	**1**	55
10	**16**	686	**8**	347	-	7	-	79	**1**	-	-	-	-	14	**8**	2	**1**	4	**2**	13	-	56
5	**7**	61	-	1	-	1	-	20	**1**	-	-	1	-	13	**12**	3	**1**	4	-	10	**2**	57
5	**3**	23	-	5	**2**	4	-	4	-	-	-	-	-	23	**8**	1	-	13	**1**	-	-	58
3	**10**	24	-	-	-	3	-	10	**1**	1	**1**	-	-	17	**9**	-	**1**	6	**2**	15	**1**	59
15	**15**	140	**3**	43	-	-	-	16	-	-	**1**	-	-	12	**17**	2	**3**	-	-	42	**3**	60
3	**12**	-	-	1	-	9	-	9	-	1	-	-	-	13	**5**	-	**2**	2	-	33	**1**	61
7	**7**	16	-	8	-	4	-	43	**1**	-	**1**	-	-	12	**2**	-	-	-	-	35	-	62
-	**8**	2	-	4	-	1	-	22	-	-	-	-	-	6	**7**	-	**3**	1	-	-	**2**	63
11	**29**	9	-	25	-	2	-	13	-	-	-	-	-	13	**19**	1	**3**	2	-	13	-	64
4	**4**	22	-	25	-	4	-	14	-	3	**1**	-	-	8	**6**	3	**2**	5	-	15	-	65
8	**16**	22	-	76	-	3	-	27	-	39	-	-	-	19	**8**	1	-	3	-	1	-	66
-	**7**	-	**1**	-	-	2	-	11	**1**	-	-	-	-	4	**5**	-	**2**	4	-	-	-	67
3	**11**	85	**1**	4	-	-	-	13	-	-	-	-	-	15	**8**	-	**2**	1	-	25	-	68
3	**7**	161	**2**	2	-	1	-	35	**1**	-	-	-	-	5	**4**	-	**1**	8	**1**	-	**1**	69
2	**8**	30	-	58	-	-	-	2	-	-	-	-	-	3	**7**	-	**1**	4	**1**	15	**2**	70
4	**15**	5	-	52	-	2	-	15	-	-	-	-	-	10	**29**	3	**5**	4	**1**	19	**1**	71
97	*318*	*1,681*	*15*	*624*	-	*75*	-	*549*	*7*	*20*	*4*	*2*	-	*390*	*301*	*52*	*55*	*90*	*14*	*314*	*19*	72
1	**8**	101	**1**	78	-	2	-	14	-	-	-	-	-	14	**6**	-	**2**	1	**1**	5	-	73
2	**6**	11	**1**	-	-	1	-	4	-	-	-	-	-	9	**14**	-	**4**	3	**1**	-	**3**	74
1	**8**	-	-	-	-	-	-	5	-	-	-	1	-	12	**8**	-	**5**	-	-	5	**6**	75
-	**3**	7	-	-	-	3	-	17	**1**	-	-	-	-	14	**9**	-	**2**	1	-	2	**3**	76
2	**24**	110	**2**	-	-	2	-	4	-	1	-	-	-	15	**9**	1	**2**	2	-	1	-	77
2	**5**	23	**1**	13	-	2	-	13	-	1	-	-	-	25	**8**	2	-	-	-	2	**1**	78
3	**8**	93	-	54	-	3	-	22	-	1	**1**	-	-	6	**3**	1	**1**	1	-	-	-	79
1	**4**	58	-	10	-	-	-	24	-	-	-	-	-	12	**2**	1	**1**	-	-	25	-	80
2	**7**	25	-	3	-	2	-	103	**4**	-	-	-	-	6	**14**	1	**1**	5	-	-	-	81
1	**6**	59	-	85	-	-	-	10	-	-	-	-	-	6	**7**	4	**3**	5	-	3	-	82
11	**18**	44	**1**	1	-	-	-	14	**1**	-	-	-	-	15	**9**	-	**5**	9	**1**	-	-	83
7	**7**	73	-	38	-	8	-	15	-	3	-	-	-	9	**2**	1	-	3	-	105	-	84
3	**6**	13	-	4	-	1	-	10	-	-	-	-	-	3	**3**	1	-	3	-	8	-	85
2	**9**	46	-	-	-	-	-	10	-	-	-	-	-	8	**2**	1	-	-	-	4	-	86
6	**12**	2	-	17	-	2	-	20	-	-	-	1	-	3	**4**	2	**3**	-	-	3	-	87
-	**7**	3	-	13	-	1	-	1	-	-	**1**	-	-	7	**6**	1	**1**	3	-	6	-	88
-	**3**	26	-	-	-	2	-	-	-	-	-	-	-	4	**2**	-	-	2	-	-	-	89
2	**8**	47	-	2	-	2	-	6	-	-	-	-	-	11	**4**	2	-	-	-	11	**1**	90
3	**6**	5	-	22	-	2	-	4	-	-	-	-	-	10	**7**	-	**1**	2	-	-	-	91
-	**4**	2	-	-	-	-	-	3	-	-	-	-	-	8	**8**	1	**1**	1	-	-	-	92
-	**4**	9	-	1	-	1	-	5	-	-	-	-	-	5	**1**	-	**1**	3	-	1	-	93
-	**7**	56	-	41	-	3	-	29	-	2	**1**	-	-	7	**3**	1	**1**	3	-	21	-	94
2	**8**	15	-	15	-	3	-	4	-	-	-	-	-	8	**6**	-	-	8	**2**	13	-	95
-	**4**	6	-	-	-	1	-	3	-	-	-	-	-	10	**3**	1	**1**	1	**1**	7	-	96
1	**6**	2	-	2	-	1	-	27	-	-	-	-	-	3	**5**	-	-	1	-	-	-	97
1	**8**	48	**2**	2	-	2	-	7	-	-	-	-	-	8	**7**	1	**1**	-	-	-	-	98
-	**10**	8	**1**	-	-	-	-	5	-	-	-	-	-	9	**5**	1	**1**	3	**1**	5	-	99
5	**6**	58	**2**	-	-	1	-	5	-	-	-	-	-	9	**5**	1	-	5	-	1	-	100
-	**24**	-	-	-	-	-	-	-	-	-	-	-	-	4	**39**	-	**1**	1	**1**	3	-	101
1	**2**	1	-	-	-	-	-	10	-	-	-	-	-	6	**4**	-	**1**	1	**1**	-	**1**	102
-	**9**	5	-	6	-	-	-	1	-	-	-	-	-	21	**16**	-	-	3	-	-	-	103

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis.		19A Chicken Pox.		9 Diphtheria.		14 Dysentery.		61A Epi. Cerebrospinal Meningitis.		19B German Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
104	Mansfield,	6,032	–	–	17	–	2	–	–	–	–	–	11	–
105	Winchendon,	6,010	2	–	31	–	22	**1**	–	–	–	–	–	–
106	Canton,	5,988	–	–	45	–	40	–	–	–	1	–	16	–
107	Tewksbury,	5,934	–	–	–	–	–	–	–	–	–	–	–	–
108	Lexington,	5,812	–	–	71	–	10	–	–	–	–	–	3	–
109	Amherst,	5,755	–	–	8	–	12	**1**	–	–	–	–	74	–
110	Walpole,	5,755	–	–	6	–	16	–	–	–	–	–	12	–
111	Dartmouth,	5,750	–	–	3	–	9	**2**	3	–	–	–	12	–
112	Abington,	5,730	2	–	20	–	6	–	–	–	–	–	2	–
113	Spencer,	5,665	–	–	–	–	2	**1**	–	–	–	–	–	–
114	Wareham,	5,651	–	–	1	–	1	–	–	–	–	–	–	–
115	Millbury,	5,540	–	–	–	–	–	**1**	–	–	–	–	–	–
116	Orange,	5,421	–	–	–	–	5	–	–	**1**	–	–	–	–
117	Hingham,	5,396	1	**1**	14	–	2	–	–	–	–	–	7	–
118	South Hadley,	5,305	–	–	5	–	1	–	–	–	–	–	16	–
119	Chelmsford,	5,258	–	–	2	–	13	**2**	–	–	–	–	4	–
120	Barnstable,	5,136	–	–	3	–	1	**1**	3	–	1	–	8	–
121	Monson,	5,112	–	–	4	–	8	–	–	–	–	–	6	–
122	Easton,	5,031	1	–	–	–	–	–	–	**2**	–	–	–	–
123	Uxbridge,	5,031	–	–	2	–	1	–	–	–	–	–	–	–
124	Agawam,	5,021	–	–	–	**1**	18	**4**	–	–	–	–	–	–
125	Towns 2,500–5,000.	*181,232*	*5*	*2*	*232*	–	*234*	*16*	*63*	*4*	*6*	*5*	*335*	–
126	Randolph,	4,926	–	–	–	–	17	**1**	–	–	–	–	–	–
127	Lee,	4,633	–	–	8	–	5	–	–	–	–	–	3	–
128	Dudley,	4,420	–	–	10	–	11	**1**	–	–	–	–	–	–
129	Rockport,	4,418	1	**1**	6	–	3	–	–	–	–	–	1	–
130	Warren,	4,303	–	–	–	–	2	–	–	–	–	–	–	–
131	Dracut,	4,270	–	–	–	–	5	–	–	–	1	–	–	–
132	Provincetown,	4,262	–	–	11	–	8	–	–	–	–	–	6	–
133	Falmouth,	4,259	–	–	3	–	–	–	–	–	–	–	–	–
134	Templeton,	4,225	–	–	–	–	10	**1**	–	–	1	**1**	–	–
135	Williamstown,	4,102	–	–	1	–	1	–	–	**1**	–	–	124	–
136	Dalton,	3,986	–	–	1	–	–	–	–	–	–	–	–	–
137	East Bridgewater,	3,833	–	–	1	–	5	**1**	–	–	1	–	–	–
138	Medfield,	3,728	–	–	11	–	3	–	60	–	–	–	2	–
139	Foxborough,	3,707	–	–	14	–	22	**2**	–	–	–	–	–	–
140	Barre,	3,705	–	–	16	–	7	–	–	–	–	–	1	–
141	Blackstone,	3,690	–	–	–	–	6	**1**	–	–	–	–	–	–
142	Auburn,	3,661	–	–	–	–	–	–	–	–	–	–	–	–
143	Somerset,	3,633	1	–	2	–	7	**1**	–	–	–	–	3	–
144	Hardwick,	3,627	–	–	–	–	1	–	–	–	–	–	–	–
145	Oxford,	3,527	–	–	–	–	3	–	–	–	–	–	–	–
146	Westport,	3,409	–	–	11	–	2	–	–	–	–	–	17	–
147	Leicester,	3,360	–	–	–	–	1	–	–	–	–	–	–	–
148	Lenox,	3,322	–	–	6	–	–	–	–	–	–	–	–	–
149	Nantucket,	3,256	–	–	–	–	3	–	–	–	–	–	18	–
150	Shrewsbury,	3,169	–	–	–	–	–	–	–	–	–	–	–	–
151	Manchester,	3,065	–	–	5	–	4	**2**	–	–	–	–	2	–
152	Holbrook,	3,006	–	–	–	–	1	–	–	–	–	–	–	–
153	Deerfield,	2,973	–	–	–	–	–	–	–	–	–	–	–	–
154	West Bridgewater,	2,966	–	–	–	–	4	**1**	–	–	–	–	2	–
155	Hadley,	2,960	1	–	–	–	2	–	–	–	–	–	–	–
156	Seekonk,	2,931	–	–	–	–	–	–	–	–	–	**1**	–	–
157	Hatfield,	2,915	–	–	5	–	7	–	–	–	–	–	3	–
158	Medway,	2,912	–	–	6	–	–	–	–	–	–	–	–	–
159	Cohasset,	2,895	–	–	6	–	3	–	–	–	–	–	–	–
160	North Brookfield,	2,890	–	–	–	–	4	–	–	–	–	–	–	–
161	Pepperell,	2,889	–	–	5	–	6	–	–	–	–	–	6	–
162	Hopedale,	2,855	1	–	–	–	7	**1**	–	–	–	**1**	1	–
163	Westford,	2,839	–	–	7	–	2	–	–	–	–	–	50	–

to the Public Health, 1917 — Continued.

92 Lobar Pneumonia.		6 Measles.		19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		100 Septic Sore Throat.		75A Trachoma.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
2	**3**	19	–	72	–	14	–	2	–	1	–	–	–	1	**1**	–	**2**	1	–	3	–	104
3	**7**	6	–	7	–	–	–	–	–	–	–	–	–	14	**7**	2	**3**	1	–	–	–	105
1	**6**	19	–	17	–	–	–	2	–	–	–	–	–	21	**6**	20	**1**	1	**1**	39	**2**	106
–	**1**	1	–	–	–	–	–	–	–	–	–	–	–	2	**1**	–	–	–	**3**	–	–	107
3	**3**	251	**1**	3	–	1	–	11	–	4	**1**	–	–	7	**5**	–	–	–	–	4	–	108
2	**1**	179	**1**	73	–	1	–	12	–	4	–	–	–	2	–	–	**1**	–	–	1	–	109
3	**1**	9	–	5	–	1	–	9	–	1	–	–	–	4	**3**	–	**1**	1	–	1	–	110
4	**6**	26	**1**	2	–	2	–	8	**1**	–	–	–	–	4	**3**	–	–	1	–	6	–	111
–	**1**	1	–	3	–	3	–	24	–	–	–	–	–	3	**3**	–	–	1	–	7	–	112
–	**2**	–	–	–	–	1	–	1	–	–	–	–	–	–	**4**	–	–	–	–	–	–	113
11	**6**	13	–	3	–	4	–	17	–	–	–	–	–	6	**7**	–	**1**	5	–	–	–	114
–	**2**	–	–	–	–	–	–	–	–	–	–	–	–	–	**4**	–	–	–	–	–	**2**	115
–	**1**	17	–	–	–	–	–	12	–	–	–	–	–	2	**2**	–	**2**	2	–	–	–	116
5	**6**	55	–	3	–	1	–	1	–	–	–	–	–	2	**1**	2	–	1	–	2	–	117
–	**2**	50	–	1	–	–	–	9	–	–	–	–	–	2	**2**	1	–	–	–	–	–	118
2	**3**	21	–	4	–	1	–	6	–	–	–	–	–	6	**6**	3	–	1	**1**	–	–	119
1	**1**	15	–	18	–	1	–	15	–	2	–	–	–	6	**2**	–	**1**	–	–	1	–	120
–	**5**	43	–	5	–	–	–	2	–	–	–	–	–	13	**10**	–	**1**	–	–	14	–	121
1	**7**	–	–	–	–	–	–	6	–	–	–	–	–	2	**4**	–	–	–	–	–	–	122
–	**6**	–	–	–	–	–	–	6	–	–	–	–	–	5	**4**	–	**2**	1	–	5	–	123
–	**1**	–	**1**	1	–	–	–	11	–	–	–	–	–	1	**5**	–	**1**	4	–	–	–	124
31	*155*	*1,049*	*16*	*188*	–	*22*	–	*154*	*1*	*2*	*2*	*1*	–	*157*	*153*	*16*	*26*	*47*	*4*	*62*	*9*	125
–	**1**	–	–	–	–	–	–	–	–	–	–	–	–	2	**3**	–	–	–	–	–	**5**	126
–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	**1**	1	–	127
–	**4**	1	**1**	1	–	1	–	2	–	–	–	–	–	4	**1**	–	**1**	–	–	–	–	128
1	**3**	–	–	–	–	–	–	7	–	–	–	1	–	4	–	1	**3**	3	**1**	1	–	129
–	**4**	–	–	–	–	–	–	3	–	–	–	–	–	2	**5**	1	–	2	–	–	–	130
–	**5**	1	–	–	–	1	–	1	–	–	–	–	–	2	**7**	–	**2**	–	–	–	–	131
–	–	15	–	4	–	2	–	5	–	–	–	–	–	4	**1**	1	–	–	–	7	–	132
–	**5**	9	–	1	–	–	–	–	–	–	–	–	–	5	**5**	–	**2**	2	–	–	–	133
–	**1**	73	–	–	–	–	–	3	–	–	–	–	–	4	**6**	–	**1**	1	–	–	–	134
4	**4**	53	–	2	–	–	–	9	–	–	–	–	–	3	**1**	–	–	–	–	6	–	135
2	**3**	98	**1**	11	–	–	–	3	–	–	**1**	–	–	2	–	–	**2**	–	–	–	–	136
1	**1**	–	–	–	–	1	–	6	**1**	–	–	–	–	24	**11**	–	**1**	–	–	3	**1**	137
–	**17**	20	–	2	–	–	–	5	–	–	–	–	–	2	**15**	–	**2**	–	–	–	–	138
–	**10**	2	–	–	–	–	–	5	–	–	–	–	–	2	**6**	–	–	–	–	–	–	139
–	**2**	3	–	–	–	–	–	4	–	–	–	–	–	1	**4**	–	–	–	–	–	–	140
–	**11**	–	–	–	–	–	–	2	–	–	–	–	–	8	**5**	–	**1**	1	–	–	–	141
–	**3**	–	–	1	–	–	–	4	–	–	–	–	–	–	**2**	–	–	1	–	–	–	142
2	**1**	33	**7**	–	–	1	–	3	–	–	–	–	–	1	**4**	–	–	2	–	4	**2**	143
–	**1**	–	–	1	–	–	–	–	–	–	–	–	–	3	**4**	–	–	–	–	2	–	144
–	**7**	1	–	–	–	–	–	–	–	–	–	–	–	–	**3**	–	–	–	–	–	–	145
–	**2**	8	–	2	–	–	–	2	–	–	–	–	–	5	**3**	–	**1**	1	–	5	–	146
–	**5**	–	–	–	–	–	–	–	–	–	–	–	–	1	**2**	–	–	–	–	–	–	147
–	**2**	25	–	–	–	–	–	–	–	–	–	–	–	4	**4**	1	**1**	1	–	–	–	148
–	**2**	33	–	–	–	–	–	1	–	–	–	–	–	1	**2**	–	–	–	–	–	–	149
–	**2**	–	–	–	–	–	–	–	–	–	–	–	–	–	**2**	–	–	1	–	–	–	150
–	**2**	1	–	85	–	2	–	5	–	–	–	–	–	4	**3**	–	**1**	–	–	–	**1**	151
1	**2**	2	–	–	–	–	–	3	–	–	–	–	–	1	**1**	–	–	1	–	3	–	152
1	**2**	62	–	3	–	–	–	1	–	–	–	–	–	2	**1**	1	–	–	–	–	–	153
1	**2**	3	–	1	–	–	–	3	–	–	–	–	–	1	**1**	1	**1**	–	–	–	–	154
–	**1**	–	–	–	–	–	–	1	–	–	–	–	–	4	**3**	–	–	–	–	–	–	155
–	**1**	–	**2**	–	–	–	–	–	–	–	–	–	–	–	**5**	–	**1**	–	–	–	–	156
1	**2**	59	–	4	–	1	–	3	–	–	–	–	–	2	**1**	–	–	–	–	1	–	157
–	**3**	3	–	1	–	1	–	1	–	–	–	–	–	2	**3**	–	–	–	–	–	–	158
–	–	39	–	12	–	2	–	1	–	–	–	–	–	2	–	–	**1**	–	–	3	–	159
–	**3**	20	–	–	–	–	–	5	–	–	–	–	–	4	**2**	–	**1**	13	–	–	–	160
–	**4**	3	–	–	–	–	–	1	–	–	–	–	–	2	**2**	–	–	–	–	–	–	161
–	**4**	10	–	4	–	–	–	6	–	–	–	–	–	1	–	1	**1**	–	–	1	–	162
1	**2**	7	–	3	–	–	–	8	–	–	–	–	–	1	**3**	–	–	5	–	–	–	163

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis.		19A Chicken Pox.		9 Diphtheria.		14 Dysentery.		61A Epi. Cerebrospinal Meningitis.		19B German Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
164	Holliston,	2,822	–	–	3	–	1	–	–	–	–	–	1	–
165	Hanover,	2,816	–	–	6	–	2	–	–	1	–	–	–	–
166	Swansea,	2,814	–	–	1	–	3	–	–	–	1	1	–	–
167	Ayer,	2,771	–	–	1	–	8	–	–	–	–	–	26	–
168	Bourne,	2,760	–	–	–	–	–	–	–	–	–	–	13	–
169	Scituate,	2,741	–	–	14	–	1	1	–	–	–	–	2	–
170	Sutton,	2,719	1	1	–	–	2	–	–	–	–	–	–	–
171	Wrentham,	2,710	–	–	10	–	11	–	2	–	–	–	2	–
172	Acushnet,	2,694	–	–	4	–	–	–	1	1	–	–	25	–
173	Holden,	2,676	–	–	27	–	7	–	–	–	–	–	–	–
174	Kingston,	2,640	–	–	–	–	4	1	–	–	–	–	–	–
175	Lancaster,	2,638	–	–	5	–	13	1	–	–	–	–	11	–
176	Dighton,	2,616	–	–	1	–	4	1	–	–	–	–	–	–
177	Norton,	2,607	–	–	3	–	–	–	–	–	1	1	–	–
178	Wilbraham,	2,605	–	–	–	–	10	–	–	1	1	–	1	–
179	Sharon,	2,538	–	–	5	–	1	–	–	–	–	–	14	–
180	Wilmington,	2,538	–	–	17	–	5	–	–	–	–	–	1	–
181	Towns under 2,500.	*213,171*	*11*	*2*	*265*	*1*	*262*	*22*	–	*4*	–	*1*	*453*	–
182	Hopkinton,	2,485	–	–	6	–	2	–	–	–	–	–	1	–
183	Billerica,	2,447	–	–	–	–	8	–	–	–	–	–	–	–
184	Weston,	2,446	–	–	9	–	14	–	–	–	–	–	1	–
185	Groveland,	2,432	3	–	4	–	–	–	–	–	–	–	–	–
186	Groton,	2,412	1	–	–	–	–	–	–	–	–	–	–	–
187	Hull,	2,372	–	–	1	–	5	1	–	–	–	–	1	–
188	Rehoboth,	2,328	–	–	–	–	5	–	–	–	–	–	–	–
189	Shirley,	2,300	–	–	6	–	23	–	–	1	–	–	62	–
190	Charlton,	2,293	–	–	3	–	–	–	–	1	–	–	–	–
191	Avon,	2,230	–	–	20	–	–	–	–	–	–	–	–	–
192	Harwich,	2,207	–	–	–	–	1	1	–	–	–	–	3	–
193	Douglas,	2,191	–	–	–	–	2	–	–	–	–	–	2	–
194	Acton,	2,158	1	1	9	–	1	–	–	–	–	–	5	–
195	Ashland,	2,148	–	–	5	–	1	–	–	–	–	–	1	–
196	Williamsburg,	2,112	–	–	1	–	1	–	–	–	–	–	–	–
197	East Longmeadow,	2,109	–	–	2	–	6	–	–	–	–	–	2	–
198	Georgetown,	2,102	–	–	1	–	2	–	–	–	–	–	2	–
199	Belchertown,	2,066	–	–	–	–	2	1	–	–	–	–	–	–
200	Bellingham,	2,066	–	–	1	–	3	–	–	–	–	–	2	–
201	Merrimac,	2,057	1	–	–	–	5	–	–	–	–	–	–	–
202	Ashburnham,	2,037	–	–	1	–	–	–	–	–	–	–	–	–
203	Duxbury,	2,024	–	–	4	–	2	–	–	–	–	–	2	–
204	Upton,	2,021	–	–	–	–	1	–	–	–	–	–	–	–
205	Millville,	2,021	–	–	–	–	1	1	–	–	–	–	–	–
206	Brookfield,	1,995	–	–	–	–	1	–	–	–	–	–	10	–
207	Southborough,	1,966	–	–	4	–	2	–	–	–	–	–	–	–
208	Rutland,	1,962	–	–	–	–	–	–	–	–	–	–	2	–
209	Wayland,	1,956	–	–	–	–	–	–	–	–	–	–	–	–
210	Hamilton,	1,936	–	–	5	–	–	–	–	–	–	–	–	–
211	Stockbridge,	1,887	–	–	1	–	1	–	–	–	–	–	18	–
212	Sheffield,	1,882	–	–	–	–	–	–	–	–	–	–	55	–
213	Colrain,	1,868	–	–	4	–	1	–	–	–	–	–	42	–
214	Raynham,	1,848	–	–	–	–	1	–	–	–	–	–	–	–
215	Northfield,	1,844	–	–	1	–	2	–	–	–	–	–	4	–
216	Northborough,	1,834	–	–	–	–	3	–	–	–	–	–	–	–
217	Townsend,	1,834	–	–	3	–	5	1	–	–	–	–	3	–
218	Longmeadow,	1,826	–	–	10	–	4	–	–	–	–	–	3	–
219	Sherborn,	1,815	–	–	22	–	–	–	–	–	–	–	1	–
220	Dennis,	1,780	–	–	–	–	6	–	–	–	–	–	4	–
221	Hanson,	1,770	–	–	1	–	–	–	–	–	–	–	–	–
222	Freetown,	1,747	–	–	–	–	2	–	–	–	–	–	–	–
223	Salisbury,	1,743	1	–	–	–	3	–	–	–	–	–	–	–

to the Public Health, 1917 — Continued.

92 Lobar Pneumonia.		6 Measles.		19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		100 Septic Sore Throat.		75A Trachoma.		28–29 Tuberculosis, Pulmonary.		30–35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
–	1	10	1	–	–	–	–	3	–	–	–	–	–	2	1	–	–	–	–	–	–	164
–	2	–	–	2	–	1	–	–	–	–	–	–	–	1	5	–	1	–	–	13	–	165
1	3	17	1	–	–	1	–	1	–	–	–	–	–	1	2	–	–	1	–	2	–	166
2	5	46	1	–	–	1	–	–	–	1	–	–	–	1	2	–	–	2	–	1	–	167
–	1	6	–	2	–	–	–	–	–	–	–	–	–	3	1	–	–	–	–	1	–	168
1	–	147	–	4	–	–	–	–	–	1	–	–	–	2	–	–	1	–	–	1	–	169
–	1	1	–	3	–	–	–	1	–	–	–	–	–	3	2	–	–	–	–	1	–	170
8	3	2	–	–	–	–	–	3	–	–	–	–	–	8	6	–	1	1	–	1	–	171
–	1	29	–	1	–	3	–	1	–	–	–	–	–	4	–	–	–	6	1	–	–	172
–	2	20	–	–	–	1	–	5	–	–	–	–	–	5	2	–	–	–	–	5	–	173
–	3	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	174
2	1	95	–	27	–	–	–	6	–	–	1	–	–	1	–	6	–	–	–	–	–	175
1	2	–	1	–	–	–	–	5	–	–	–	–	–	1	–	–	–	2	1	–	–	176
–	–	6	–	3	–	–	–	3	–	–	–	–	–	2	2	–	–	–	–	–	–	177
–	2	–	1	–	–	1	–	11	–	–	–	–	–	5	6	–	–	–	–	–	–	178
1	1	67	–	7	–	–	–	1	–	–	–	–	–	5	3	3	–	–	–	–	–	179
–	3	17	–	1	–	2	–	11	–	–	–	–	–	2	–	–	–	–	–	–	–	180
28	*178*	*1,452*	*10*	*469*	–	*19*	–	*270*	*2*	*6*	*3*	–	–	*134*	*331*	*8*	*23*	*53*	*6*	*135*	*7*	181
–	4	4	–	22	–	–	–	10	–	–	–	–	–	3	3	–	–	–	–	1	–	182
1	2	37	–	2	–	–	–	1	–	–	–	–	–	–	3	–	1	–	–	1	–	183
–	1	8	–	1	–	–	–	–	–	–	1	–	–	2	2	–	1	–	–	9	–	184
1	1	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	185
–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	186
1	1	29	–	2	–	1	–	9	–	–	–	–	–	1	1	–	–	–	–	4	–	187
–	3	1	–	1	–	–	–	–	–	–	–	–	–	–	2	–	2	2	–	–	–	188
–	–	11	–	4	–	–	–	1	–	–	–	–	–	1	3	–	–	–	–	–	–	189
–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	190
1	–	2	–	29	–	–	–	3	–	–	–	–	–	1	3	–	1	1	–	3	–	191
–	1	11	–	–	–	–	–	–	–	–	–	–	–	2	1	–	–	1	–	–	–	192
1	1	2	–	10	–	–	–	–	–	–	–	–	–	3	3	1	–	–	–	1	–	193
–	7	1	–	1	–	–	–	1	–	–	–	–	–	1	1	–	–	–	–	1	–	194
–	1	3	–	37	–	–	–	4	–	–	–	–	–	7	3	–	–	1	1	–	–	195
–	1	19	–	1	–	–	–	4	–	–	–	–	–	7	2	–	–	2	–	–	–	196
–	1	2	–	–	–	–	–	1	–	–	–	–	–	3	1	–	1	1	–	–	–	197
–	5	2	–	–	–	–	–	27	1	–	–	–	–	2	2	–	1	–	–	–	–	198
–	3	2	–	–	–	–	–	3	–	–	–	–	–	–	2	–	–	1	–	–	–	199
–	5	–	–	–	–	–	–	1	–	–	–	–	–	4	1	–	–	–	–	–	–	200
–	1	153	–	6	–	–	–	–	–	–	–	–	–	3	4	–	1	–	–	–	–	201
–	3	–	–	8	–	–	–	2	–	–	–	–	–	1	2	–	–	1	–	9	2	202
–	–	6	–	1	–	2	–	5	–	–	–	–	–	–	1	–	–	–	–	3	–	203
–	2	18	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	8	1	204
–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	4	–	1	–	1	–	–	205
–	1	65	–	1	–	–	–	–	–	–	–	–	–	1	1	–	–	–	1	–	1	206
–	–	2	–	–	–	–	–	5	–	–	–	–	–	–	1	–	–	–	–	–	–	207
–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	62	–	–	–	–	1	–	208
–	–	–	–	–	–	–	–	7	–	–	–	–	–	1	–	–	–	–	–	–	–	209
–	2	2	–	–	–	–	–	1	–	–	–	–	–	1	1	–	–	–	–	–	–	210
1	1	–	–	–	–	–	–	–	–	–	–	–	–	3	2	–	–	–	–	1	–	211
1	1	–	–	1	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	212
2	2	89	1	2	–	–	–	10	–	1	–	–	–	1	2	–	–	3	–	16	–	213
–	1	–	–	–	–	–	–	1	–	–	–	–	–	2	2	–	3	–	–	–	–	214
–	2	14	–	15	–	–	–	1	–	–	–	–	–	2	–	–	–	–	–	–	–	215
–	1	1	–	–	–	–	–	2	1	–	–	–	–	2	2	–	–	1	–	–	–	216
–	4	1	–	3	–	–	–	1	–	–	–	–	–	1	1	–	–	–	–	4	–	217
–	4	7	–	–	–	–	–	1	–	–	–	–	–	1	2	–	–	1	–	1	–	218
–	3	3	–	1	–	–	–	–	–	–	–	–	–	3	–	–	–	1	–	–	–	219
–	2	1	–	–	–	–	–	–	–	–	–	–	–	3	3	–	–	–	–	4	–	220
–	2	12	–	–	–	–	–	3	–	–	–	–	–	3	–	1	–	3	–	–	–	221
–	–	–	–	–	–	–	–	6	–	–	–	–	–	3	3	–	–	–	–	1	–	222
–	1	34	–	1	–	2	–	3	–	–	–	–	–	2	3	–	–	–	–	4	–	223

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis.		19A Chicken Pox.		9 Diphtheria.		14 Dysentery.		61A Epi. Cerebrospinal Meningitis.		19B German Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
224	Marshfield,	1,719	–	–	–	–	1	–	–	–	–	–	1	–
225	Carver,	1,718	–	–	–	–	–	–	–	–	–	–	–	–
226	Chatham,	1,713	–	–	–	–	11	4	–	–	–	–	2	–
227	Lunenburg,	1,705	–	–	16	–	10	–	–	–	–	–	16	–
228	Essex,	1,702	–	–	–	–	–	–	–	–	–	–	–	–
229	Westminster,	1,700	–	–	15	–	3	–	–	–	–	–	–	–
230	Lakeville,	1,645	–	–	–	–	2	–	–	–	–	–	–	–
231	Newbury,	1,638	–	–	–	–	3	1	–	–	–	–	–	–
232	Norwell,	1,631	–	–	–	–	–	–	–	–	–	–	1	–
233	Buckland,	1,567	–	–	–	–	–	–	–	–	–	–	1	–
234	West Newbury,	1,554	–	–	–	–	4	–	–	–	–	–	–	–
235	Cheshire,	1,550	1	–	–	–	–	–	–	–	–	1	–	–
236	Rowley,	1,531	–	–	–	–	–	–	–	–	–	–	3	–
237	Westwood,	1,528	–	–	1	–	–	–	–	–	–	–	–	–
238	Southwick,	1,517	–	–	–	–	–	–	–	–	–	–	–	–
239	Marion,	1,498	–	–	11	–	–	–	–	–	–	–	1	–
240	Shelburne,	1,477	1	–	–	–	1	–	–	–	–	–	27	–
241	Nahant,	1,477	–	–	–	–	–	–	–	–	–	–	2	–
242	Sturbridge,	1,468	–	–	–	–	1	–	–	–	–	–	–	–
243	Millis,	1,461	–	–	–	–	–	–	–	–	–	–	–	–
244	Bedford,	1,424	–	–	–	–	3	–	–	–	–	–	–	–
245	Sterling,	1,423	–	–	–	–	2	–	–	–	–	–	–	–
246	Plainville,	1,419	–	–	2	–	1	–	–	–	–	–	1	–
247	Sandwich,	1,416	–	–	14	1	–	–	–	–	–	–	10	–
248	Yarmouth,	1,413	–	–	1	–	–	–	–	–	–	–	–	–
249	Huntington,	1,405	–	–	–	–	3	–	–	–	–	–	–	–
250	Mattapoisett,	1,405	–	–	4	–	–	1	–	–	–	–	8	–
251	Norfolk,	1,404	–	–	–	–	–	1	–	–	–	–	–	–
252	North Reading,	1,395	–	–	1	–	–	–	–	–	–	–	2	–
253	Middleton,	1,387	1	1	1	–	–	–	–	–	–	–	–	–
254	Tisbury,	1,381	–	–	11	–	–	–	–	–	–	–	14	–
255	Sunderland,	1,380	–	–	–	–	1	1	–	–	–	–	–	–
256	Lincoln,	1,370	–	–	5	–	–	–	–	–	–	–	1	–
257	West Boylston,	1,340	–	–	8	–	–	–	–	–	–	–	24	–
258	Pembroke,	1,337	–	–	–	–	1	–	–	–	–	–	–	–
259	Chester,	1,329	–	–	–	–	–	–	–	–	–	–	3	–
260	Hinsdale,	1,319	–	–	–	–	–	–	–	–	–	–	4	–
261	Oak Bluffs,	1,316	–	–	2	–	1	–	–	–	–	–	8	–
262	Edgartown,	1,314	–	–	6	–	–	–	–	–	–	–	8	–
263	West Stockbridge,	1,279	–	–	1	–	1	–	–	–	–	–	–	–
264	West Brookfield,	1,271	–	–	–	–	–	–	–	–	–	–	–	–
265	Sudbury,	1,244	–	–	1	–	–	–	–	–	–	–	–	–
266	Whately,	1,238	–	–	–	–	4	–	–	1	–	–	–	–
267	Littleton,	1,228	–	–	–	–	2	–	–	–	–	–	9	–
268	Conway,	1,216	–	–	–	–	–	–	–	–	–	–	–	–
269	Orleans,	1,206	–	–	20	–	2	–	–	–	–	–	–	–
270	Lynnfield,	1,201	–	–	–	–	1	–	–	–	–	–	–	–
271	Rochester,	1,191	–	–	3	–	–	–	–	–	–	–	2	–
272	Erving,	1,177	–	–	3	–	27	1	–	–	–	–	11	–
273	Topsfield,	1,173	–	–	–	–	1	–	–	–	–	–	–	–
274	Russell,	1,166	–	–	–	–	–	–	–	–	–	–	–	–
275	Lanesborough,	1,151	–	–	–	–	–	–	–	–	–	–	–	–
276	Harvard,	1,135	–	–	–	–	–	–	–	–	–	–	1	–
277	Stow,	1,132	–	–	4	–	2	–	–	–	–	–	2	–
278	Wenham,	1,094	–	–	–	–	–	–	–	–	–	–	–	–
279	Hubbardston,	1,089	–	–	–	–	5	1	–	–	–	–	–	–
280	Dover,	1,088	–	–	–	–	–	–	–	–	–	–	3	–
281	Clarksburg,	1,073	–	–	–	–	2	1	–	–	–	–	–	–
282	Tyngsborough,	1,028	–	–	4	–	1	–	–	–	–	–	2	–
283	Ashfield,	1,009	–	–	–	–	–	–	–	–	–	–	5	–
284	New Marlborough,	988	–	–	–	–	–	–	–	–	–	–	14	–
285	Southampton,	985	–	–	–	–	–	–	–	–	–	–	2	–
286	Becket,	979	–	–	–	–	–	–	–	–	–	–	8	–

to the Public Health, 1917 — Continued.

92		6		19C		38A		7		100		75A		28-29		30-35		1		8		
Lobar Pneumonia.		Measles.		Mumps.		Ophthalmia Neonatorum.		Scarlet Fever.		Septic Sore Throat.		Trachoma.		Tuberculosis, Pulmonary.		Tuberculosis, Other Forms.		Typhoid Fever.		Whooping Cough.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
1	3	1	–	2	–	–	–	–	–	–	–	–	–	–	2	–	–	2	–	3	–	224
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	225
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	226
–	1	6	–	13	–	2	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	227
–	6	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	228
–	3	88	–	3	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	229
–	1	1	–	–	–	–	–	–	–	–	–	–	–	2	83	–	1	–	–	–	–	230
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	231
–	–	1	–	2	–	1	–	–	–	–	–	–	–	–	1	1	–	–	–	1	–	232
1	1	26	–	–	–	1	–	10	–	–	–	–	–	2	1	–	–	1	–	7	–	233
–	1	4	–	7	–	–	–	4	–	–	–	–	–	1	2	–	–	–	–	–	–	234
–	1	1	–	1	–	–	–	2	–	–	–	–	–	–	1	–	–	–	–	–	–	235
–	2	26	2	–	–	–	–	2	–	–	–	–	–	–	2	–	–	4	–	–	–	236
–	2	–	–	3	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	237
–	2	–	–	–	–	–	–	3	–	–	–	–	–	–	2	–	–	–	–	–	–	238
–	1	11	–	24	–	1	–	3	–	–	–	–	–	1	–	–	–	–	–	–	–	239
–	2	21	–	–	–	–	–	19	–	–	–	–	–	–	1	–	–	–	–	7	–	240
–	2	1	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	241
–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	242
–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	1	–	–	–	–	–	–	243
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	1	244
–	–	3	–	24	–	–	–	–	–	–	1	–	–	1	–	–	–	2	–	7	–	245
–	–	3	–	–	–	–	–	8	–	–	–	–	–	1	–	–	–	–	–	–	–	246
–	–	1	–	4	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	247
–	1	1	–	3	–	–	–	4	–	–	1	–	–	1	–	–	1	–	–	–	–	248
–	1	–	–	–	–	–	–	5	–	–	–	–	–	–	2	–	–	–	–	–	–	249
–	–	68	–	21	–	–	–	8	–	–	–	–	–	6	2	–	–	–	–	2	–	250
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	1	–	–	–	251
1	2	2	–	3	–	2	–	–	–	–	–	–	–	1	51	–	–	–	–	5	–	252
–	2	3	–	–	–	1	–	–	–	–	–	–	–	–	1	–	–	1	–	–	–	253
4	3	1	–	91	–	–	–	–	–	–	–	–	–	3	1	–	–	1	–	–	–	254
2	1	16	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	255
–	–	1	–	–	–	–	–	1	–	–	–	–	–	2	1	–	–	–	–	–	–	256
–	1	83	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	6	–	257
–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	258
–	–	4	–	–	–	–	–	–	–	–	–	–	–	2	2	–	–	–	–	1	–	259
–	–	18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	260
–	3	6	–	4	–	–	–	–	–	–	–	–	–	1	–	–	–	1	1	–	–	261
1	1	–	–	2	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	262
–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	263
–	1	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	264
–	–	4	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	265
–	1	21	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	266
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	267
–	3	32	–	1	–	–	–	1	–	–	–	–	–	1	–	–	1	–	–	–	–	268
–	1	–	–	–	–	–	–	2	–	–	–	–	–	–	–	1	1	1	–	–	–	269
–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	270
–	1	1	–	2	–	–	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–	271
1	–	1	–	2	–	–	–	11	–	–	–	–	–	–	–	–	–	–	–	5	1	272
–	1	2	–	–	–	1	–	–	–	–	–	–	–	2	1	–	–	–	–	–	–	273
–	1	6	–	–	–	2	–	2	–	–	–	–	–	–	1	–	–	2	1	–	–	274
–	–	8	–	–	–	–	–	5	–	–	–	–	–	–	2	–	–	–	–	2	–	275
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	276
–	1	2	–	1	–	–	–	2	–	–	–	–	–	1	–	–	–	–	–	–	–	277
–	–	1	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	278
1	–	1	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	1	–	–	–	279
–	–	1	–	–	–	–	–	–	–	1	–	–	–	1	–	–	1	–	–	–	–	280
–	1	–	1	–	–	–	–	–	–	–	–	–	–	1	1	–	1	–	–	–	–	281
–	1	–	–	–	–	–	–	5	–	–	–	–	–	–	1	–	–	–	–	–	–	282
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	283
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	284
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	285
–	–	19	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	286

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis.		19A Chicken Pox.		9 Diphtheria.		14 Dysentery.		61A Epi. Cerebrospinal Meningitis.		19B German Measles.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
287	Berkley,	979	–	–	–	–	–	–	–	–	–	–	–	–
288	Charlemont,	966	–	–	–	–	4	–	–	–	–	–	–	–
289	Brimfield,	964	–	–	–	–	2	–	–	–	–	–	–	–
290	Mendon,	957	–	–	–	–	3	–	–	–	–	–	–	–
291	Gill,	955	–	–	–	–	–	–	–	–	–	–	2	–
292	Ashby,	938	–	–	–	–	7	1	–	–	–	–	–	–
293	Wellfleet,	898	–	–	–	–	–	–	–	–	–	–	2	–
294	Royalston,	893	–	–	–	–	–	–	–	–	–	–	–	–
295	Granby,	857	–	–	–	–	–	–	–	–	–	–	–	–
296	Brewster,	850	–	–	–	–	–	–	–	–	–	–	–	–
297	Berlin,	846	–	–	–	–	1	–	–	–	–	–	–	–
298	Burlington,	822	–	–	–	–	1	–	–	–	–	–	–	–
299	Boylston,	814	–	–	–	–	–	–	–	–	–	–	–	–
300	Bernardston,	812	–	–	–	–	–	–	–	–	–	–	1	–
301	Leverett,	801	–	–	–	–	–	–	–	–	–	–	2	–
302	Princeton,	792	–	–	–	–	1	–	–	–	–	–	–	–
303	Granville,	786	–	–	–	–	–	–	–	–	–	–	–	–
304	Enfield,	776	–	–	–	–	–	–	–	–	–	–	–	–
305	Bolton,	770	–	–	–	–	2	1	–	–	–	–	–	–
306	Petersham,	714	–	–	–	–	–	–	–	–	–	–	–	–
307	Boxford,	712	–	–	–	–	2	–	–	–	–	–	–	–
308	Dana,	701	–	–	–	–	7	2	–	–	–	–	–	–
309	Hampden,	681	–	–	–	–	2	–	–	–	–	–	–	–
310	Halifax,	677	–	–	–	–	–	–	–	–	–	–	–	–
311	Cummington,	671	–	–	–	–	–	–	–	–	–	–	–	–
312	Truro,	667	–	–	–	–	–	–	–	–	–	–	8	–
313	Worthington,	640	–	–	–	–	–	–	–	–	–	–	–	–
314	New Salem,	619	–	–	3	–	2	1	–	–	–	–	–	–
315	Plympton,	616	–	–	–	–	–	–	–	–	–	–	–	–
316	Egremont,	597	–	–	–	–	–	–	–	–	–	–	–	–
317	Blandford,	581	1	–	–	–	–	–	–	1	–	–	–	–
318	Chesterfield,	570	–	–	1	–	–	–	–	–	–	–	3	–
319	Sandisfield,	563	–	–	–	–	2	1	–	–	–	–	–	–
320	Eastham,	557	–	–	–	–	–	–	–	–	–	–	8	–
321	Hancock,	536	–	–	–	–	–	–	–	–	–	–	–	–
322	Savoy,	534	–	–	–	–	–	–	–	–	–	–	–	–
323	Richmond,	526	–	–	–	–	–	–	–	–	–	–	–	–
324	Oakham,	516	–	–	–	–	–	–	–	–	–	–	–	–
325	Pelham,	513	–	–	–	–	5	–	–	–	–	–	2	–
326	Paxton,	495	–	–	–	–	–	–	–	–	–	–	–	–
327	Warwick,	477	–	–	–	–	1	–	–	–	–	–	–	–
328	Carlisle,	463	–	–	1	–	3	–	–	–	–	–	–	–
329	New Braintree,	448	–	–	–	–	–	–	–	–	–	–	–	–
330	West Tisbury,	443	–	–	–	–	–	–	–	–	–	–	1	–
331	Florida,	441	–	–	–	–	–	–	–	–	–	–	–	–
332	Westhampton,	433	–	–	–	–	–	–	–	–	–	–	–	–
333	Hawley,	429	–	–	–	–	1	–	–	–	–	–	–	–
334	Otis,	420	–	–	–	–	–	–	–	–	–	–	–	–
335	Greenwich,	415	–	–	–	–	–	–	–	–	–	–	–	–
336	Rowe,	410	–	–	–	–	1	–	–	–	–	–	–	–
337	Heath,	399	–	–	–	–	–	–	–	–	–	–	–	–
338	Phillipston,	374	–	–	–	–	–	–	–	–	–	–	–	–
339	Plainfield,	362	–	–	–	–	–	–	–	–	–	–	–	–
340	Windsor,	362	–	–	–	–	–	–	–	–	–	–	–	–
341	Leyden,	353	–	–	1	–	–	–	–	–	–	–	–	–
342	Monterey,	345	–	–	–	–	–	–	–	–	–	–	–	–
343	Dunstable,	342	–	–	–	–	1	–	–	–	–	–	–	–
344	Wendell,	338	–	–	–	–	–	–	–	–	–	–	–	–
345	Wales,	333	–	–	–	–	–	–	–	–	–	–	–	–
346	Boxborough,	330	–	–	–	–	–	–	–	–	–	–	–	–
347	Monroe,	318	–	–	–	–	–	–	–	–	–	–	–	–
348	Middlefield,	312	–	–	–	–	–	–	–	–	–	–	–	–
349	Tyringham,	304	–	–	–	–	–	–	–	–	–	–	–	–

to the Public Health, 1917 — Continued.

92 Lobar Pneumonia.		6 Measles.		19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		100 Septic Sore Throat.		75A Trachoma.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	287
–	–	24	1	–	–	–	–	5	–	–	–	–	–	1	–	1	1	–	–	–	–	288
–	1	21	–	3	–	–	–	–	–	–	–	–	–	1	1	–	–	1	–	–	–	289
–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	290
–	1	8	–	51	–	–	–	9	–	–	–	–	–	1	1	–	–	–	–	1	–	291
–	–	–	–	26	–	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	292
–	–	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	293
–	3	8	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	1	–	–	–	294
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	295
–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	296
–	4	1	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	297
–	2	3	–	1	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	298
–	1	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	299
–	3	23	–	–	–	–	–	5	–	–	–	–	–	–	–	–	–	–	–	–	–	300
3	–	37	1	–	–	1	–	2	–	–	–	–	–	1	–	–	–	–	–	2	–	301
–	2	38	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	302
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	303
–	–	5	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	2	–	–	–	304
–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	305
–	–	2	–	–	–	–	–	1	–	–	–	–	–	2	–	–	–	–	–	–	–	306
–	–	1	–	–	–	–	–	3	–	–	–	–	–	–	–	–	1	–	–	6	–	307
1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	308
–	–	4	–	–	–	–	–	4	–	–	–	–	–	–	–	–	–	–	–	–	–	309
–	–	1	–	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	310
–	1	9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	311
–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	312
–	–	9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	313
1	1	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	314
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	315
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	1	–	–	–	316
–	–	36	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	317
1	–	80	–	1	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	318
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	319
–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	320
–	–	1	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	321
–	–	4	–	–	–	–	–	3	–	–	–	–	–	1	1	–	–	–	–	–	–	322
–	2	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	323
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	324
1	–	8	–	1	–	–	–	1	–	1	–	–	–	2	1	–	–	–	–	–	–	325
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	326
–	–	14	–	1	–	–	–	–	–	1	–	–	–	–	–	–	1	2	1	–	–	327
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2	–	–	–	–	–	–	328
–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	329
–	–	–	–	12	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	330
–	1	15	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	331
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	332
–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	333
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	334
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	335
–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	336
–	1	15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	337
–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	338
–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	339
–	–	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	340
–	1	8	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	341
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	342
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	343
–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	344
–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	345
–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	–	–	346
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	347
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	348
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	349

Cases and Deaths from Diseases Dangerous

Line No.	Cities and Towns grouped in Order of Population.	Population estimated as of July 1, 1917.	63A Anterior Poliomyelitis. Cases.	63A Anterior Poliomyelitis. Deaths.	19A Chicken Pox. Cases.	19A Chicken Pox. Deaths.	9 Diphtheria. Cases.	9 Diphtheria. Deaths.	14 Dysentery. Cases.	14 Dysentery. Deaths.	61A Epi. Cerebrospinal Meningitis. Cases.	61A Epi. Cerebrospinal Meningitis. Deaths.	19B German Measles. Cases.	19B German Measles. Deaths.
350	Shutesbury,	303	–	–	–	–	1	–	–	–	–	–	–	–
351	Goshen,	293	–	–	–	–	–	–	–	–	–	–	–	–
352	Chilmark,	291	–	–	–	–	–	–	–	–	–	–	–	–
353	Prescott,	290	–	–	1	–	–	–	–	–	–	–	–	–
354	Washington,	274	–	–	–	–	1	–	–	–	–	–	–	–
355	Alford,	269	–	–	–	–	–	–	–	–	–	–	1	–
356	Mashpee,	261	–	–	–	–	–	–	–	–	–	–	–	–
357	Montgomery,	236	–	–	–	–	–	–	–	–	–	–	–	–
358	Tolland,	208	–	–	–	–	–	–	–	–	–	–	–	–
359	Gay Head,	181	–	–	–	–	–	–	–	–	–	–	–	–
360	Peru,	177	–	–	–	–	–	–	–	–	–	–	–	–
361	Holland,	165	–	–	–	–	–	–	–	–	–	–	–	–
362	Gosnold,	157	–	–	–	–	–	–	–	–	–	–	–	–
363	New Ashford,	92	–	–	–	–	–	–	–	–	–	–	–	–
364	Mount Washington,	87	–	–	–	–	–	–	–	–	–	–	–	–
365	State Infirmary,	. .	–	–	12	1	20	8	–	–	1	–	–	–
366	Camp Devens,	. .	–	–	–	–	9	–	–	–	2	1	36	–

In addition to the above there occurred 4 cases of actinomycosis, with 3 deaths: —

	Cases.	Deaths.
Boston,	1	–
Cambridge,	1	–
Danvers,	1	1
Everett,	–	1
Westwood,	1	1

54 cases of anthrax, with 11 deaths: —

	Cases.	Deaths.
Berlin,	1	–
Beverly,	1	–
Boston,	13	4
Camp Devens,	1	–
Chelsea,	1	2
Greenfield,	1	–
Hudson,	1	–
Lynn,	3	–
Malden,	2	–
North Adams,	1	–
Peabody,	2	–
Salem,	2	–
Saugus,	1	–
Stoneham,	1	–
Waltham,	–	1
Weymouth,	1	1
Winchester,	3	–
Woburn,	19	3

60 cases of dog bite (on final investigation 26 of these proved to have been bitten by rabid dogs): —

	Cases.	Deaths.
Attleboro,	7	–
Auburn,	1	–
Boston,	6	–
Brockton,	5	–
Canton,	1	–
Chelsea,	1	–
Dartmouth,	2	–
Fall River,	1	–
Falmouth,	2	–
Holliston,	2	–
Holyoke,	1	–
Lawrence,	7	–
Lowell,	9	–
Medford,	1	–
Newburyport,	1	–
North Adams,	2	–
Northampton,	1	–
Pittsfield,	1	–
Salisbury,	1	–
Sunderland,	1	–
Waltham,	1	–
West Boylston,	2	–
Worcester,	4	–

2 cases of glanders, with 1 death: —

	Cases.	Deaths.
Springfield,	1	1
State Infirmary,	1	–

1 case of hookworm disease: —

	Cases.	Deaths.
Boston,	1	–

3 cases of leprosy, with 1 death: —

	Cases.	Deaths.
Boston,	1	–
Gosnold,	1	1
Springfield,	1	–

78 cases of malaria, with 5 deaths: —

	Cases.	Deaths.
Amherst,	1	–
Boston,	24	–
Brockton,	2	1
Brookline,	3	–
Cambridge,	2	–
Canton,	1	–
Chelsea,	1	–
Chicopee,	2	–
Danvers,	1	–
Dedham,	11	–
Douglas,	2	–
Erving,	4	–
Fall River,	2	–

to the Public Health, 1917 — Concluded.

92 Lobar Pneumonia.		6 Measles.		19C Mumps.		38A Ophthalmia Neonatorum.		7 Scarlet Fever.		100 Septic Sore Throat.		75A Trachoma.		28-29 Tuberculosis, Pulmonary.		30-35 Tuberculosis, Other Forms.		1 Typhoid Fever.		8 Whooping Cough.		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Line No.
-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	350
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	351
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	352
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	353
-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	354
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	355
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	356
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	357
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	358
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	359
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	360
-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	361
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	362
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	363
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	364
4	19	5	-	1	-	1	-	52	8	-	-	-	-	270	213	12	14	66	4	4	-	365
6	5	124	-	3	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	366

	Cases.	Deaths.
Foxborough,	1	-
Framingham,	1	-
Haverhill,	2	-
Hull,	1	-
Lynn,	1	-
Marblehead,	2	-
Medfield,	1	-
Milford,	1	1
Millville,	-	1
Montague,	1	-
Natick,	1	-
Newton,	4	-
Northampton,	1	-
Pittsfield,	1	-
Somerville,	1	-
Springfield,	-	1
Sutton,	1	-
Waltham,	-	1
Wellesley,	1	-
Worcester,	1	-

29 cases of pellagra, with 20 deaths: —

	Cases.	Deaths.
Boston,	5	4
Chelsea,	1	-
Danvers,	2	3
Fall River,	1	-
Foxborough,	-	1
Lawrence,	1	-
Lowell,	2	3
Lynn,	1	-
Malden,	1	1
Middleton,	1	-
Milford,	1	1
Natick,	1	-
Northampton,	2	-
Peabody,	1	1
Somerville,	1	-
Stoneham,	-	1
Taunton,	2	1
Tewksbury State Infirmary,	4	4
Worcester,	2	-

65 cases of smallpox, with 10 deaths: —

	Cases.	Deaths.
Bernardston,	1	-
Beverly,	2	-
Boston,	5	-
Blackstone,	1	-
Brookline,	1	-
Fitchburg,	4	1
Lee,	1	-
Lowell,	1	-
Malden,	1	-
Shrewsbury,	3	-
Springfield,	1	-
Ware,	1	-
Webster,	3	-
Winchendon,	1	-
Worcester,	39	9

28 cases of tetanus, with 15 deaths: —

	Cases.	Deaths.
Boston,	2	1
Brockton,	1	1
Dennis,	1	1
Gardner,	2	-
Lawrence,	1	1
Malden,	1	1
New Bedford,	3	2
Peabody,	3	2
Pittsfield,	3	3
Springfield,	3	-
Sterling,	1	-
Waltham,	-	1
Wareham,	-	1
Westfield,	2	1
Winchester,	2	-
Worcester,	3	-

3 cases of trichinosis, with 2 deaths: —

	Cases.	Deaths.
Boston,	2	-
North Adams,	1	1
Taunton,	-	1

DIVISION OF BIOLOGIC LABORATORIES.

DIVISION OF BIOLOGIC LABORATORIES.

Report of the Antitoxin and Vaccine Laboratory, Forest Hills, Mass.

RUDOLPH KOHN, M.D., ASSISTANT DIRECTOR.

The process of immunization of the diphtheria antitoxin horses was not materially changed during the course of the year, except that a greater number of horses were put on small daily injections in order to get quicker and more satisfactory immunization.

The production of antimeningitis serum was recommenced towards the end of the fiscal year owing to depletion of stock; the number of strains of meningococci used for immunization was increased from 32 to 49. All meningococcus cultures were obtained from the Rockefeller Institute, New York City. The method used was that of Amoss, with the modification of four daily injections employed instead of three. The number of horses used at present for production of antimeningitis serum is four. Further steps were taken to find and incorporate among our immunizing strains any new strains occurring throughout the State of Massachusetts not covered by our present antimeningitis serum.

As authorized by an act of the Legislature May 3, 1917, the production of antipneumococcus serum was commenced this year. Starting from the hypothesis that while one set of antibody-producing cells is more or less refractory, another set of different order should be correspondingly active, — perhaps a permissible extension of the law of compensation, — those of our diphtheria antitoxin horses which could not produce a satisfactory antitoxin — immunity produced by connective tissue cells — were transferred to production of antipneumococcus serum, — immunity probably produced by blood-forming organs. Seven horses in all were immunized against either Type I. or Type II. pneumococci, according to Cole's method. The immunity response was very satisfactory.

The number of horses in the stables on Dec. 1, 1916, was 24; on Dec. 1, 1917, 28; the number acquired during the year was 12. Eight

horses were disposed of; 2 were chloroformed and bled; 5 died; 1 was exchanged as unsuitable for our work. Of the horses that died; 1 was shot because the antitoxic contents of the serum were not high enough to warrant bleeding and concentration; 1 broke a leg and had to be shot; 1 slipped and injured the fifth cervical vertebra and died six days later; 1 was found dead in the morning without having shown any signs of illness the previous night, — autopsy showed extensive distention of intestines with gas, inflammation of ilium, circumscribed inflammatory patches on mucous membrane of stomach, rupture of diaphragm on left side; and the fifth died after three days' illness, — autopsy did not show very marked changes, — diagnosis of intestinal toxemia.

The demand for diphtheria antitoxin has increased appreciably, — from 174,435 to 218,603 thousand-unit doses. The efforts to concentrate all antitoxin, while successful for a time, were interrupted by our inability to obtain necessary supplies. Only towards the end of the fiscal year was it possible to resume concentration. The present rate of distribution of diphtheria antitoxin is higher than the production, and it therefore has become necessary to increase production considerably.

The production of antipneumococcus serum was remarkably successful. All 7 horses immunized gave serum of the highest grade known: 4 horses produced a Type I. serum, of which 0.2 cubic centimeter will regularly protect against at least 0.2 cubic centimeter of a fully virulent culture of pneumococci of the same type if injected simultaneously into the peritoneal cavity of white mice; 3 horses produced a Type II. serum, of which 0.2 cubic centimeter will protect against 0.1 cubic centimeter of a virulent culture of Type II. pneumococcus. As it had not been possible previously to produce a Type II. serum of which 0.2 cubic centimeter would protect regularly against more than 0.01 cubic centimeter of culture, the production of Type II. serum was discontinued, owing to its poor clinical results. With the present Type II. serum it is expected that results will be more encouraging.

The prevention of pneumonia being a public health problem of the first magnitude, some work was undertaken on the prophylactic treatment against pneumonia. Though the number of persons and animals subjected to experimental treatment have been fewer than might be advisable, it was the maximum that could be undertaken under the circumstances, and a few practical conclusions may be drawn from the work done.

1. It seems possible to measure immunity in man against the different types of pneumococcus infection by determining the protective

power of the blood serum against pneumococcus infection of mice. The average serum of man protects against 20 to 50 times the minimum lethal dose of pneumococcus culture in mice. In rare cases normal natural protection was found against Type I. and none against Type II., and *vice versa.*

2. Natural immunity appears to be unstable, as a severe cold may lower natural protection.

3. If the protective power of the human serum against pneumococcus infection in mice is taken as a guide, man can be immunized against Types I., II., and probably III., his serum protecting against at least 0.001 cubic centimeter and in some cases 0.01 cubic centimeter of a culture of the homologous type.

4. A small number of persons so immunized did not show an appreciable loss of immunity after eight months. One case had lost most of her acquired immunity.

5. It appears, therefore, that active immunity can be acquired by injections with killed pneumococci of the most prevalent and virulent types and will last at least one year, probably two, and possibly longer. Constitutional symptoms after injection were never observed; sometimes a very slight local reaction was seen.

6. The vaccine consists of a mixture of Types I., II. and III. pneumococci, 500,000,000 of each type, or 1,500,000,000 in 1 cubic centimeter. The pneumococci are killed by adding 0.4 per cent. tricresol (no heating). Three injections of 1 cubic centimeter each were given on three different schedules: (1) injections on three successive days; (2) injections on the fourth day; (3) injections every seven days.

There does not appear to be much difference in the resulting immunity whichever mode of injection is chosen. The best results were obtained with daily injections, which in view of the small number of subjects might very well be accidental. The vaccine should be as fresh as possible; seven days appears to be the limit; a vaccine several months old will produce no immunity whatever.

7. It is recommended that the prophylactic treatment be given a practical test on a large scale, when all the finer details and phases of this process can be studied. Furthermore it is realized that there is no evidence that a person so immunized is really protected against pneumonia, and such evidence can be obtained only by test on a large scale. It is also possible, though not probable, that the acquired immunity under adverse conditions might be lowered to the danger point or entirely lost. It is also probable that a certain percentage of people will be more or less refractory to treatment, and therefore cannot be protected.

General Summary.

Number of horses on hand Dec. 1, 1916: —	
Antimeningitis,	4
Diphtheria antitoxin,	16
Antipneumococcus,	4
Total,	24
Number of horses acquired Dec. 1, 1916, to Nov. 30, 1917,	12
Number of horses disposed of Dec. 1, 1916, to Nov. 30, 1917,	8
Number of horses on hand Nov. 30, 1917: —	
Antimeningitis,	4
Diphtheria antitoxin,	19
Antipneumococcus,	5
Total,	28

Production and Distribution.

Diphtheria antitoxin: —	
Number of liters distributed Dec. 1, 1916, to Nov. 30, 1917,	990.2
Number of 1,000-units distributed Dec. 1, 1916, to Nov. 30, 1917,	218,603
Number of liters on hand Nov. 30, 1917,	577
Number of 1,000-units on hand Nov. 30, 1917,	115,400
Antimeningitis serum: —	
Number of liters on hand Dec. 1, 1916,	26,955
Number of liters produced Dec. 1, 1916, to Nov. 30, 1917,	7,400
Number of liters procured from New York Department of Health,	8,000
Total,	42,355
Number of liters distributed Dec. 1, 1916, to Nov. 30, 1917,	30,075
Number of liters on hand Nov. 30, 1917,	12,280
Total,	42,355
Antipneumococcus serum: —	
Number of liters produced to Nov. 30, 1917, Type I.,	45,625
Number of liters produced to Nov. 30, 1917, Type II.,	27,075
Number of liters distributed to Nov. 30, 1917, Type I.,	6,000
Number of liters distributed to Nov. 30, 1917, Type II.,	9,700
Number of liters on hand Nov. 30, 1917, Type I.,	39,625
Number of liters on hand Nov. 30, 1917, Type II.,	17,375

General distribution of diphtheria antitoxin: —

Number of 1,000 units in 750-unit packages,	4,201
Number of 1,000 units in 1,500-unit packages,	21,103
Number of 1,000 units in 2,000-unit packages,	920
Number of 1,000 units in 3,000-unit packages,	113,793
Number of 1,000 units in 6,000-unit packages,	31,698
Number of 1,000 units in 12,000-unit packages,	46,888
Total,	218,603

Number of liters of serum sent to State for general distribution,	990.2

Average number of units per cubic centimeter in 750-unit package,	250.0
Average number of units per cubic centimeter in 1,500-unit package,	300.0
Average number of units per cubic centimeter in 3,000-unit package,	304.0
Average number of units per cubic centimeter in 6,000-unit package,	218.0
Average number of units per cubic centimeter in 12,000-unit package,	216.0

Globulin antitoxin: —

Number of liters of normal serum precipitated,	480.0
Number of liters of globulin serum produced,	120.0
Average number of units per cubic centimeter of globulin serum,	480.0

Diphtheria toxin (Culture Park No. 8): —

Number of liters of toxin in stock Dec. 1, 1916,	–
Number of liters of toxin in stock Nov. 30, 1917,	27
Number of liters of toxin made Dec. 1, 1916, to Nov. 30, 1917,	309
Average strength of toxin in minimum lethal doses,	.0048

General distribution of antimeningitis serum: —

Number of bottles of 15 cubic centimeters each,	2,005

General distribution of antipneumococcus serum: —

Number of 100 cubic centimeter bottles of Type I.,	60
Number of 100 cubic centimeter bottles of Type II.,	97

Distribution of Schick toxin outfits: —

Number of outfits enough for 50 persons each,	62

Vaccine Virus, 1917.

The work of the year has followed closely the lines indicated in previous reports. Particular care has been taken to select calves best suited for the propagation of vaccine virus. Fat, smooth-skinned, well-bred animals have been employed whenever they could be found. By

vaccinating these one at a time, it was possible to give special attention to the individual, thus securing more perfect eruption and a higher yield of vaccine per calf (95.2 cubic centimeters).

Calves inoculated and Vaccine produced Dec. 1, 1916, to Nov. 30, 1917.

When inoculated.	Number of Calves.	Designation.	Yield of Vaccine.	
			Cubic Centimeters.	1/60 Cubic Centimeter Doses.
1916.				
December 14,	2	510	60	3,600
		511	60	3,600
1917.				
January 18,	2	512	80	4,800
		513[1]	–	–
February 15,	2	514[1]	–	–
		515	70	4,200
February 23,	2	516	100	6,000
		517	115	6,900
March 5,	1	518	80	4,800
March 15,	1	519	100	6,000
April 5,	1	520	60	3,600
April 12,	1	521	110	6,600
April 20,	1	522	70	4,200
April 26,	1	523	120	7,200
May 11,	2	524	100	6,000
		525	100	6,000
May 24,	2	526	100	6,000
		527	70	4,200
June 7,	1	528[2]	–	–
June 22,	2	529	85	5,100
		530	80	4,800
September 6,	1	531	165	9,900
September 27,	1	532	135	8,100
November 8,	1	533	140	8,400
Totals,	24	–	2,000	120,000

[1] Not a good "take." [2] Vaccine not used on account of injury to tongue.

Distribution of Vaccine Virus by Months.

Month.	Doses of Vaccine Virus sent out.	Month.	Doses of Vaccine Virus sent out.
1916.		**1917** — Con.	
December,	5,895	June,	13,968
		July,	15,130
1917.		August,	41,177
January,	5,853	September,	30,039
February,	4,220	October,	7,000
March,	6,501	November,	8,900
April,	10,035	Total,	180,521
May,	31,803		

Typhoid and Paratyphoid Prophylactic — Distribution by Months, in 1 Cubic Centimeter Doses.

Month.	Typhoid Prophylactic.	Paratyphoid A and B.	Triple Mixture.
1916.			
December,	1,500	-	-
1917.			
January,	1,700	-	-
February,	2,800	-	-
March,	6,500	-	-
April,	11,500	104	-
May,	9,400	419	3,855
June,	4,325	200	1,050
July,	4,150	375	650
August,	4,975	950	3,750
September,	5,850	375	2,125
October,	8,043	150	1,863
November,	11,150	150	2,850
Totals,	71,893	2,723	16,143

Report of the Wassermann Laboratory.

WILLIAM A. HINTON, M.D., ASSISTANT DIRECTOR.

Wassermann Tests.

A comparison of the Wassermann tests made during the past three years shows a gradual increase, the most noteworthy increase being in the number of specimens submitted by practicing physicians.

Table I. — *Showing Growth of Wassermann Service.*

	Institutions and Physicians served.			Number of Specimens.		
	1915 (Six Months).	1916 (Twelve Months).	1917 (Twelve Months).	1915 (Six Months).	1916 (Twelve Months).	1917 (Twelve Months).
State institutions,	15	21	25	6,350	23,101	24,735
Municipal and private institutions,	27	53	65			
Physicians,	110	514	764	142	2,396	3,789
Total,	-	-	-	6,492	25,497	28,524

The increase in the number of specimens submitted by practicing physicians is largely due to a change in policy whereby the service is made more accessible to them. Physicians now may obtain Wassermann service (1) when specimens are submitted by direction of their State District Health Officer; or (2) their local board of health; or (3) through other distributing agencies approved by the State Department of Health; or (4) patients may be sent directly to the laboratory as formerly. The material change in policy has been brought about by making these various agencies distributors of outfits, the plan formerly being to have these agencies obtain the specimens themselves.

Diagnostic Examinations for the Department of Animal Industry.

The following table gives a statement of the diagnostic examinations performed for the Department of Animal Industry: —

Table II. — *Diagnostic Examinations for the Department of Animal Industry.*

	Result of Examination.				
	Positive.	Doubtful.	Negative.	Unsatisfactory.	Totals.
Complement fixation tests for glanders,	278	122	885	45	1,330
Agglutination tests for glanders,	131	74	200	18	423
Diagnostic examinations for rabies,	27	2	36	2	67
Miscellaneous examinations —					
For glanders bacilli in tissue,	-	-	-	-	1
For baccili of blackleg in tissue,	-	-	-	-	1
For anthrax bacilli in tissue,	-	-	-	-	1
Total,	-	-	-	-	1,823

Agglutination Tests for Glanders. — It is to be noted from Table II. that agglutination tests for glanders have been included. This work was undertaken on May 15 in response to a request from the Department of Animal Industry.

The test itself as employed in this laboratory consists in adding to a fixed quantity of glanders bacilli varying dilutions of the serum of suspected animals. The dilutions employed are 1 to 40, 1 to 80, 1 to 160, 1 to 320, 1 to 640, 1 to 1,280, 1 to 2,560, and 1 to 5,120. The limits of agglutination of any particular suspension by normal animals is determined by checking results obtained in this test with the result of the complement fixation test for glanders and with the ophthalmic test as employed by the Department of Animal Industry, together with the report of the autopsies on the animals destroyed by the same department. In this way a standard suspension of glanders bacilli is obtained which is used in subsequent agglutination tests. Later suspensions of glanders bacilli made for the same purpose are standardized in the same way and are run in parallel with the standard suspension as previously prepared. The agglutination phenomenon as applied to this test consists in the clumping of the glanders bacilli by the serum of a glandered animal employed. The test itself is by no means as

specific as the complement fixation test for glanders, owing to the fact that glanders bacilli may also be agglutinated (clumped) by the serum of normal animals. A positive result with this test is valuable in condemning suspected animals when the complement fixation test is negative or doubtful and where the clinical symptoms are suspicious and the ophthalmic reaction positive. The test is also useful to check up the correctness of the complement fixation test for glanders, inasmuch as our experience shows us that no wide discrepancies should appear between these two tests. Should such discrepancies appear in the examination of any particular lot of specimens both tests are repeated until satisfactory results are obtained.

Examination for Rabies. — In the last report directions were given for the disposition of domestic animals suspected of rabies. Briefly, these were that the animal suspected of being infected with rabies should be kept until a proficient veterinarian examined it, preferably one from the Department of Animal Industry. If, however, it was impossible to keep the animal alive, owing to the danger of being bitten by it, the proper directions for shipping killed animals should be obtained from the Department of Animal Industry. It is gratifying to note that during the hot summer months of last year very few animals were received in a decomposed condition because they were properly prepared for shipment according to directions given by that Department.

Seasonable Prevalence of Rabies. — It is commonly believed by the laity that rabies is a disease which occurs in domestic animals chiefly during the hot summer months. This belief accounts for the fact that more animals are submitted for examination during the hot summer months than during the other months of the year. With regard to Massachusetts, this seasonable presence of rabies is unfounded. The number of rabid dogs examined during the winter is as great as the number examined during the summer months. As this report is being written we are in the midst of what appears to be a mild epidemic of rabies. During the past twelve months there have been 25 cases of rabies in dogs and 2 cases of rabies in cows. Of this number, 16 have occurred during the last five months. Of these 16, 5 were in the month of November. The cases have come chiefly from the eastern part of the State.

It is a rule that examinations are made promptly in the manner described in the last report, thus enabling other divisions of the health department to administer adequate treatment to persons bitten by rabid animals.

Service to Military Organizations.

Following the general policy inaugurated by public institutions since the beginning of the war, the laboratory has served the government and the various agencies working for it in all instances where requests for service have been made. As examples of service rendered it may be mentioned that instruction was given to a government officer detailed to the laboratory for the purpose of learning the Wassermann technique. The laboratory also obtained and tested the blood in 161 cases in a training camp preparing men for military service. It has assisted established government laboratories by testing specimens as an aid in checking the results obtained in these military laboratories.

Complement Fixation Tests for Tuberculosis.

Recent literature on the complement fixation test for tuberculosis indicates that it has decided value in the diagnosis of tuberculosis, where other laboratory findings are negative and clinical manifestations of the disease are inconclusive. It would appear that the test is especially valuable in the diagnosis of incipient tuberculosis, so frequently most difficult to establish. For these reasons it seemed desirable for the Wassermann Laboratory to undertake this work. Furthermore its equipment and personnel fitted it for such serologic examinations. Accordingly a small appropriation was requested and granted. The preliminary work of standardizing the important reagents used in the test is requiring considerable time, and the results obtained warrant further study on this test.

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